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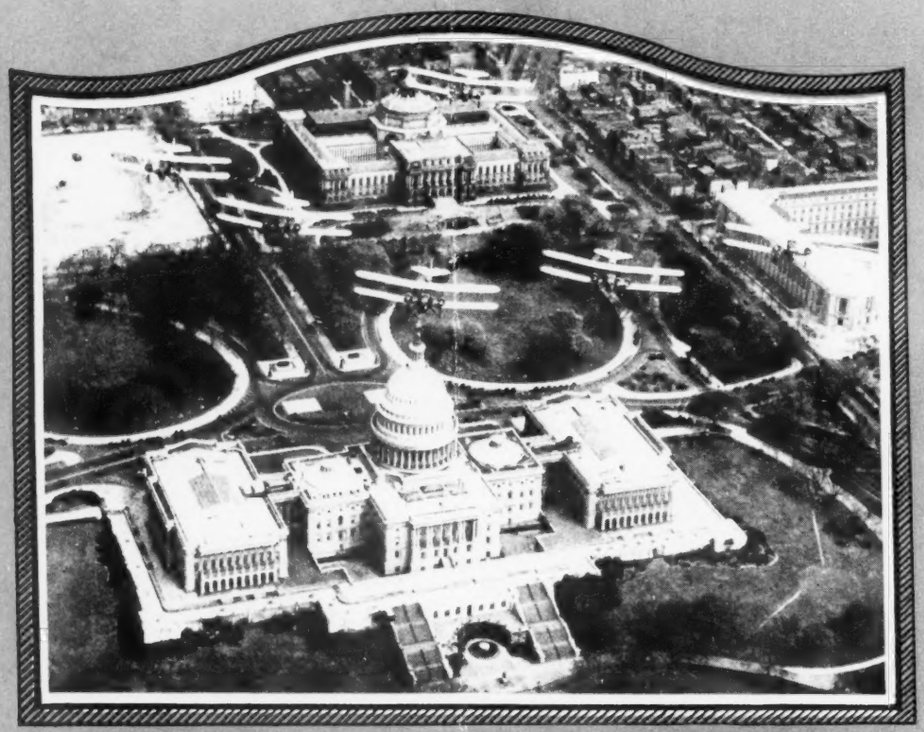

Keystone View Company, Inc.

ARMY BOMBING PLANES IN BATTLE FORMATION FLYING OVER THE CAPITOL AND NEARBY GOVERNMENT BUILDINGS IN WASHINGTON

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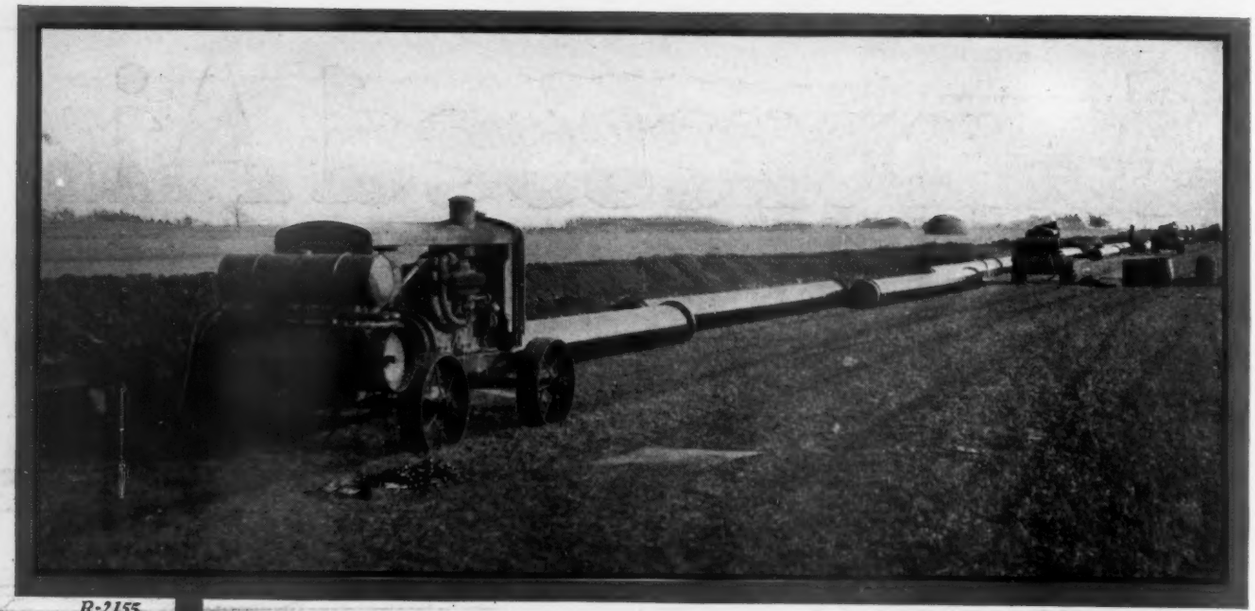

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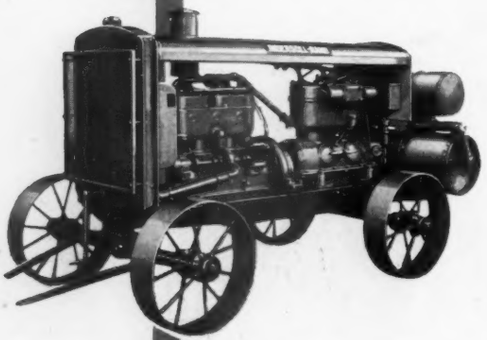
I-R Portable Compressors Speed Pipe Line Work



Type 20 portable compressor on standard steel-wheel mounting.

One of the 6 sizes of "Jackhamer" rock drills. A complete line of pneumatic diggers is also available.

The above view shows 4 Ingersoll-Rand Type 20 portable compressors working on a section of the Pan-handle-Indianapolis natural gas line of the Missouri-Kansas Pipe Line Co.

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As It Seems To Us

ICE CREAM COMES INTO ITS SEASONAL OWN

JULY, as the first of the summer months, reminds us of the return of ice cream to its seasonal supremacy in the truly American dietary. We do not feel justified in saying that babies cry for it, as they are reported to do for a certain digestive medicament, but there is no doubt about every other age of man hankering for this delectable frozen sweet.

Ice cream as an American institution had its start about the time of the Revolution; and the distinction of giving it social sanction has been attributed to various persons. There are those who ascribe leadership in this matter to fascinating DOLLY MADISON, and there is another equally earnest group who give the honor to the wife of ALEXANDER HAMILTON. Be this as it may, ice cream is now enjoyed by all walks of our national life, and it tickles with seemingly uniform effectiveness the palates of high and low. This state of affairs is no doubt largely due to the mechanical means and to the standardized processes that now make it possible to produce ice cream in great quantities so that it can be retailed at prices within the reach of all.

While the domestic freezer still serves its purpose in many thousands of households, the vast bulk of the ice cream consumed annually is the product of plants especially equipped for its manufacture. At the present time there are substantially 4,000 factories engaged in the making of ice cream; and in the course of a twelvemonth these establishments supply an aggregate of about 350,000,000 gallons of this flavorful commodity. Just how popular ice cream has become in comparatively recent years is convincingly indicated by statistics. In 1905 the per capita consumption of ice cream in this country was 1.04 gallons per annum. Today consumption is virtually at the rate of 3 gallons per capita in the course of a year! With this abundance to cool our throats, who is justified in saying that the heat of summer has not become more tolerable. Beyond question, the ice-cream manufacturer deserves our patronage and also our thanks.

The farmer may well be pleased with the growth of the ice-cream industry because the output of the factories in that business is highest just when his herds are giving him their maximum of milk. Such being the happy situation, he does not have to worry about finding a ready market for what otherwise would be an unprofitable surplus. Ice cream, once deemed something of a luxury, is now looked upon as a true foodstuff and an established item in our exceptionally varied dietary.

The manufacture of ice cream is a highly specialized industry which represents a very large investment in machinery and associate equipment. The services of specialists and technical experts are also required. The factories turn out ice cream having an annual value of more than $300,000,000; and a force of nearly 22,000 wage earners is employed. The industry is, indeed, one phase of Big Business.

SILENT LOCOMOTIVES NOW SERVE NEW YORK'S WEST SIDE

BY THE time we go to press the steam locomotive will be a thing of the past on the west side of Manhattan Island, thanks to the enterprise of the New York Central Railroad. In place of the long familiar puffing "iron horse", the handling of freight trains will henceforth be delegated in the main to a group of 30-odd oil-electric locomotives that will do their work silently and with a total absence of smoke and cinders.

One has but to recall that the Riverside Drive section of New York City, commanding the scenic sweep of the Hudson, is extensively occupied by residences and imposing apartment houses that have been reared there notwithstanding the fact that along the foot of the towering slope trains have been traveling for decades in moving enormous quantities of freight and express matter in and out of the Metropolis. The loud tooting of whistles, the belching of clouds of soot-laden smoke have been increasingly objected to by the denizens of the neighboring heights; and it was inevitable that the city authorities and the railroad officials should get together in an effort to effect an improvement in keeping with the upbuilding and the general betterment of the waterfront section through which the New York Central tracks are laid. The desired change has come about with the evolution of the oil-electric locomotive now adopted for the essential work in question. Thus has been consummated a change long desired by the public, the city government, and the railroad.

The abandonment of steam haulage will add very measurably to the comfort of the people living more or less near the railroad; it will increase the value of adjacent property; it will facilitate the beautification of the contiguous park; and it will unquestionably be the means of bringing about substantial operating economies in moving the freight and the express trains on that part of the New York Central system. The manner in which the oil-electric locomotives perform the service expected of them will, no doubt, be watched with much interest by city planners and by engineering experts of other municipalities that have confronting them kindred conditions that also call for early solution.

WHERE OUR FACTORIES ARE CONCENTRATED

SOME years ago a superpower survey made by the Government revealed that manufacturing was so concentrated in certain of the eastern states that the section was picturesquely described as the "nation's workshop". Figures are now available from the Bureau of the Census that confirm this in a measurable degree and disclose that six of the states stand out conspicuously as producers of factory-made goods.

According to the official figures, the value of manufactured commodities for the year 1929—the last twelvemonth for which complete data are at present obtainable—totaled quite $70,137,000,000. Of this output more than half had its origin in the states of New York, Pennsylvania, Illinois, Ohio, Michigan, and New Jersey. The products of these states had an aggregate value of $38,173,395,693. Taking them in the order of their manufacturing importance, we have the following figures to show the reason for their industrial leadership: New York, $9,979,958,958; Pennsylvania, $7,387,856,808; Illinois, $6,232,438,498; Ohio, $5,999,123,993; Michigan, $4,636,361,417; New Jersey, $3,937,656,019. The value of the goods originating in Massachusetts, California, Indiana, Wisconsin, Missouri, and Connecticut amounts to $14,561,127,868. Therefore, the twelve states mentioned contribute manufactured commodities worth $52,734,523,561—that is, about three-fourths of the aggregate of such goods made in the whole of the United States.

The number of officers and employees engaged in the work in question was 1,377,760; and the salaries paid totaled $3,579,624,574. Apart from the large number of people engaged and the immense amount of money involved in compensation, it should be self-evident that materials, supplies, and operating outlays of various other sorts must have reached enormous sums which, in their turn, represented the employment of thousands and thousands of contributive workers. Manifestly, any slowing up in manufacturing in the aforementioned twelve states would inevitably affect more or less seriously economic conditions not only in the twelve states but virtually throughout the length and breadth of the land. Conversely, renewed activity in the factories of those states would bring in its train benefits all along the line.

It is plain that manufacturing with us is of a decidedly sectionalized nature; and this situation necessitates normally an intensified use of transportation facilities in moving all materials to plants and then in distributing finished commodities. Our railroads are especially concerned in this great service.

Leet Brothers

One of the historic entrances to Mount Vernon.

Photo, U. S. Bureau of Public Roads

Model of terminal arrangements for parking motor vehicles at Mount Vernon.

Mount Vernon Memorial Highway Under Construction

This Beautiful Boulevard Along the West Bank of the Potomac River Will Link the National Capital With the Historic Home of George Washington

By R. C. SKERRETT

MOUNT Vernon and the City of Washington are soon to be linked by a beautiful highway intended to commemorate the two hundredth anniversary of the birth of George Washington. Thus will be brought to fruition patriotic efforts initiated nearly half a century ago by a group of Alexandria's citizens—residents of that old Virginia town so intimately identified with the life of the nation's first president.

The route chosen for the Mount Vernon Memorial Highway will follow generally the western shore of the Potomac River for a distance of substantially twelve miles; and in its completed form it will be more of a parkway than a highway. It will trace a countryside rich in historic association, and be, therefore, just that much more inspiring and instructive to the tide of tourists traveling between the National Capital and the final resting place of the mortal remains of the immortal Father of Our Country. The highway is now being constructed under the supervision of the Bureau of Public Roads of the United States Department of Agriculture; and the aim is to have the undertaking finished in the first half of 1932.

Despite the fact that Mount Vernon has long made an appeal to the public, still the number of visitors there annually was not as great as might have been expected until within comparatively recent years. This may be explained in part by the fact that for a considerable period the tourist could reach Mount Vernon only by an excursion steamer running to and from Washington. In 1885 the pilgrims to Mount Vernon numbered 35,000; but with the building of an electric line to the home of Washington, the coming of motor buses, and the multiplying of automobiles, Mount Vernon has yearly attracted larger and larger numbers. In 1928 as many as 400,000 persons visited the place—arriving, so it is reported, from every state of the Union.

Jones Lighthouse, Alexandria, at the site of the cornerstone marking the southern boundary of the original limits of the District of Columbia.

It can readily be foreseen that, in the absence of some special provision to take care of the potentially great tourist movement to Washington and its environs a year hence, present traffic facilities would be quite inadequate for the crowds bent upon reaching Mount Vernon during the period of the projected bicentennial celebration. After serving its purpose then, the memorial highway will continue to be for decades to come a commodious and a picturesque route between

Washington and Mount Vernon.

The idea of a memorial highway to Mount Vernon dates from 1886; but, despite that pioneer movement and the subsequent endorsement of Government officials and of numerous national and patriotic organizations, the project remained only such until an act of Congress was passed on May 23, 1928, authorizing and directing the United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington to take the steps necessary to construct a suitable memorial highway to connect Mount Vernon with the south end of the Arlington Memorial Bridge across the Potomac River. Funds for the work were provided at the same time.

Before starting operations, the commission considered two general routes for the highway. One route was inland and skirted the City of Alexandria, while the other lay along the shore of the Potomac and through Alexandria. The latter was wisely chosen because it offered superior possibilities for the development of park areas between the highway and the river, and it possessed outstanding scenic and historic advantages that the inland route could not offer. The river route traverses territory replete with reminders of the days of George Washington.

About halfway between Washington and Alexandria the line of the highway is close to the site of Abingdon, the home of John Custis, Mrs. Washington's son. There Nellie Custis, Washington's adopted daughter, was born; and from a vantage point nearby is a fine view of the river and a splendid panoramic vista of the City of Washington. Passing thence, the highway enters Alexandria by way of Washington Street; and that thoroughfare goes by Christ Church, where George Washington had a pew. Alexandria, as most of us are aware, was his market place, his post office, and his voting place; and in many other respects Alexandria was intimately identified with Washington and his period. It is highly befitting, therefore, that the pilgrim intent upon visiting Mount Vernon should also have a chance to halt at this quaint old Virginia town that is so rich in its associations with most of the years of Washington's life.

Where the highway leaves Alexandria on its way to Mount Vernon it passes, at the southern limits of the town, near what was once a cornerstone of the District of Columbia. That stone is standing on Jones Po and with its inscription quite legible. V ginia, it will be recalled, withdrew the sect she had originally contributed to the formati of the Federal City. From Alexandria t route crosses Hunting Creek and rises to hi ground from which an expansive view can b had of the river and the distant Capit From that point on, and continuing to ov look the Potomac, the route will follow ridge to old Fort Hunt and thence to t gates of Mount Vernon.

The highway generally will have a pav width of 40 feet except for the stretch b tween the Arlington Memorial Bridge a the underpass of the Richmond, Frederick burg & Potomac Railroad—which will be feet wide—or where it follows an establish route through Alexandria, Va. Where t pavement is divided by islands at grade cro ings, however, each of the two roadways w be 30 feet wide throughout the 40-foot se tion of the highway and 40 feet wide throug out the 60-foot section.

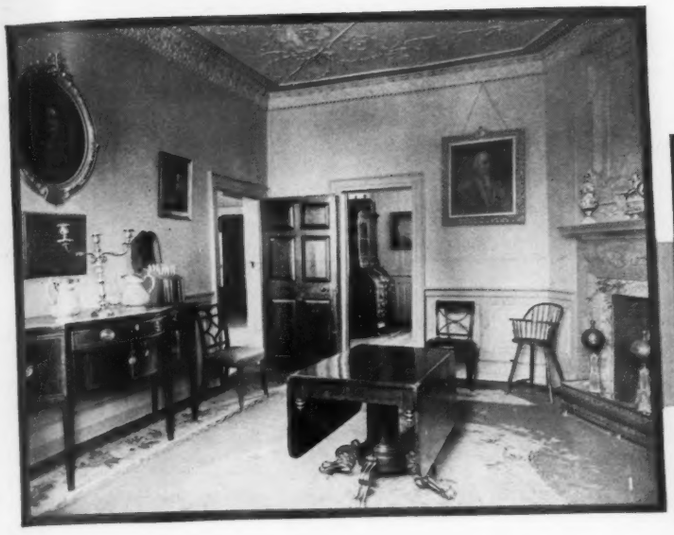
In building the memorial highway the wo is divided into four units, and each of thes has or will call for its own particular equi ment. One unit embraces an extensive ri rap foundation for a sea wall at the northe end of the route between Columbia Islan and the Pennsylvania Railroad bridge acro the Potomac; and this same unit involv all hydraulic fills. A second unit has to d with grading other than hydraulic, sma drainage structures, and incidental wor The third unit covers the construction twelve bridges at as many different poi along the route; and the fourth unit includ paving and other details. All phases of th undertaking have been either taken in ha or contracted for; and the various features, far as possible, are being advanced with practicable dispatch.

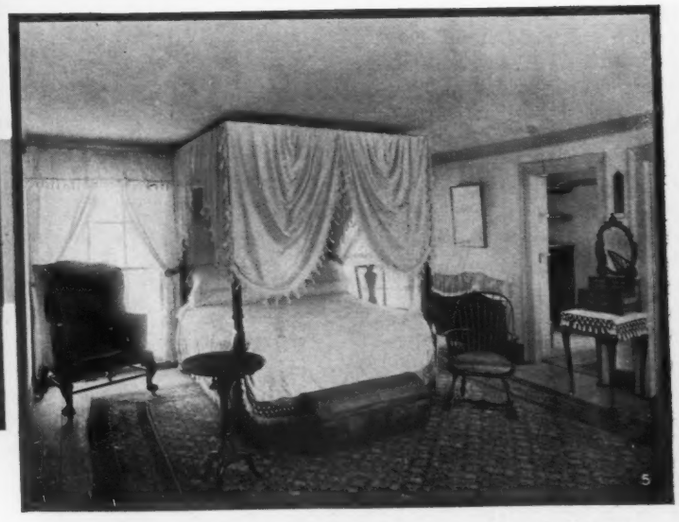
The route chosen for the highway i necessitated fills across approximately 7 miles of open water. This work is being do by hydraulic methods. Apropos of this angle the project, the commission was unable obtain satisfactory bids for the hydrau fills, and the work was therefore taken hand by the War Department, using equi ment owned by the Government. Dredgi operations were started in October, 19 The subsurface conditions at the sites of t hydraulic fills have made their construct both difficult and expensive. In part, this h been due to the heavy granular material us in the embankments for the purpose of stab lizing them within the shortest possible tim The underlying soft and unstable mater encountered at the locations for the hydrau fills has ranged in depth from 12 to 30 fe The Hunting Creek fill is across a water g underlain by 40 feet of silt; and the leng of the fill is approximately 3,000 feet. T hydraulic fill between Columbia Island an the railroad bridge has totaled substantial 750,000 cubic yards.

Except where it goes through Alexandri the highway elsewhere keeps close to the riv shore. In the vicinity of what is known a Wellington Villa, there is a residential de velopment that is spread out along th

Leet Brothers

Top—Family kitchen that once prepared all the savory things for which Mount Vernon was noted. Bottom—Coach owned and used by George Washington.





Leet Brothers

1—Family dining room at Mount Vernon. 2—The spacious main hall and the stairway leading to the second floor. 3—The mansion at Mount Vernon as it appears today. 4—Banquet hall planned by Washington. It was the scene of many festivities and ceremonial feasts. 5—George Washington's bedroom.

Photos, U. S. Bureau of Public Roads

1—Little Hunting Creek which the highway will cross. 2—Government dredge at work on a fill at Four Mile Run. 3—All that remains of the George Washington Canal Lock.

4—Underpass of electric railroad to Mount Vernon. 5—Timbered land before clearing for the highway. 6—Road under construction through a low area known as Millers' Swamp.

Potomac for a mile or more, and this has made it necessary to run the highway inland. To prevent traffic from this development slowing up traffic on the Mount Vernon Memorial Highway or promoting accidents, a system of border roads has been devised. These roads will serve the local area and permit inbound and outbound traffic from that residential section to enter and to leave the highway without hazard at predetermined points.

The bridges are generally to be of stone-faced reinforced concrete, using native stone laid in random bond. In the case of the railroad bridge, under which the highway passes, that structure is formed of curved steel girders which produce an arch effect that harmonizes well with the other bridge designs. The architectural elevations are by Gilmore D. Clarke, consulting landscape architect for the highway, and the designs have been produced by the Bureau of Public Roads.

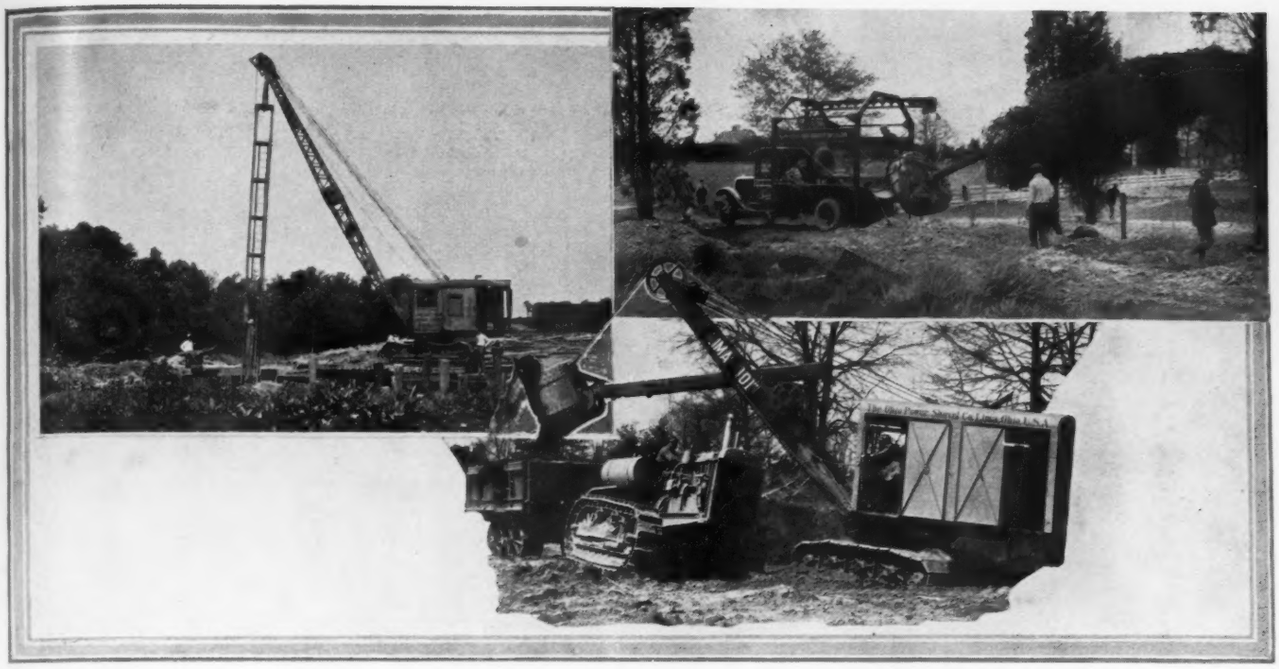
Where high elevations at various points along the highway offer commanding views of Washington or the opposite shore of the river, provision has been made for suitable overlooks which will give room for a small amount of parking. At some points islands will separate these parking places from the highway: at other points parking will be provided for by the simple expedient of widening the pavement—that is, designing it so as to widen out and to return in pleasing lines to the contours of the highway. Various features of design are intended to afford adequate traffic service for any future development that may take place between the highway and the river. Thought has been given to the problem of permitting cars to turn around and to allow for a small amount of cross traffic at grade on curves where the roadway can be so widened as to enable the placing of islands of sufficient width to facilitate the movements mentioned.

Where it has been found necessary to provide grade crossings, and the curvature is too slight to permit dividing the roadway with pleasing lines staggered outlets have been resorted to. Outlets of this kind make it possible for traffic to cross the traffic lanes on one half of the highway and then to flow with and to weave across the traffic on the other half to an exit. Needless to remark the road as now being constructed will be of ample capacity to take care of present traffic and for the demands of the future for some years to come; and the arrangements are such that further expansion can be made at a moderate outlay when conditions so warrant. The pavement will be of bituminous concrete from the beginning of the highway to the south shore of Hunting Creek at Alexandria. From that point to Mount Vernon the pavement will be of reinforced concrete.

At the Mount Vernon terminus there will be parking facilities for both automobiles and buses; and each type of vehicle will have its own reservation. As now planned, parking space will be available for 350 passenger automobiles and for about 60 buses. These facilities will answer all ordinary requirements. However, title is being taken to a contiguous area that will be sufficient to accommodate an overflow of 1,500 or more vehicles. All that would have to be done would be to resort to selective cutting of a wooded stretch so that the natural ground surface could be utilized for parking. Congress appropriated a total of $7,200,000 for this commendable and desirable undertaking, and of this sum approximately $1,000,000 will be expended for right of way and desirable park areas.

It might be well to recall the origin of Mount Vernon and to touch briefly upon its identification with the career of George Washington. As far back as 1674, Lord Culpeper granted to John Washington and Nicholas Spencer a tract of 5,000 acres situated on the west bank of the Potomac River. Half of this great expanse became the property of Lawrence Washington by descent; and he it was who built a residence on an elevation above the Potomac and named the estate Mount Vernon, after the British admiral Edward Vernon, under whom he had served between 1740 and 1742 in the West Indies during the campaign against the Spaniards. Lawrence Washington died in 1752, and the ownership of the estate passed to George Washington when he had just turned twenty—a tremendous responsibility for a mere youth.

The fact that George Washington commanded the revolutionary forces during the long struggle for independence and brought victory to that cause, and the further fact that he added still greater luster to his name as the nation's first president somewhat dim his career as a citizen, and yet it is as a private citizen that he developed those splendid characteristics that made him conspicuous as a public figure. It is as a private citizen that we need most to study him now and to pattern



Photos, U. S. Bureau of Public Roads

Left—Driving piles in work on a culvert. Right—Removing cedars on line of boulevard for planting elsewhere. Bottom—Some of the mechanical aids employed in clearing the route for the highway.

our conduct in meeting, as he did, the economic upheavals following in the footsteps of years of armed strife.

It is a matter of record that George Washington so expanded the 2,500 acres willed to him by his half-brother Lawrence Washington. that the boundaries of his far-flung plantation embraced an area of 8,000 acres at the time of his death. George Washington was preëminently a successful farmer. and he made the tilling of the soil abundantly profitable. As Woodrow Wilson has written of him: "It needed capacity and knowledge and patience of no mean order to get good farming out of slaves, and profitable prices out of London merchants; to find prompt and trustworthy ship-masters by whom to send out cargoes, and induce correspondents over sea to ship the perishable goods sent in return by the right vessels, bound to the nearest river; and the bigger your estate the more difficult its proper conduct and economy, the more disastrous in scale the effects of mismanagement."

The acres of Mount Vernon were not over fertile, but understanding skill made them so. George Washington not only produced the best tobacco in Virginia but he succeeded in having it recognized as such in England; and flour from Mount Vernon was passed without inspection by the otherwise scrutinizing officials of the British ports in the West Indies. Because of his achievements, other men in similar situations sought his counsel, and in this as in other matters his opinions carried weight. And what was Washington's daily routine when at home at Mount Vernon?

Each weekday morning, after a breakfast of Indian cakes, honey, and tea or coffee, Washington mounted his horse and rode over his plantation, spending hours in doing so and seeing to it that his people were engaged in faithfully carrying out his orders. When not so engaged he gave much thought to constructive planning and to some practical achievement to be accomplished each day. Despite these exactions he found ample time for riding to hounds and for doing the other pleasurable things deemed desirable in the social setting of his order. He was always willing and ready to serve his neighbors, his parish, his colony, and his country. George Washington had the genius of concentration and the will to achieve by patience and persistence if he thought the end worthy of the effort.

When the present generation and those that come hereafter traverse the memorial highway in their hastening conveyances, it will add to their appreciation to know something about the means of travel used by George Washington in his journeys that took him northward to Georgetown, Annapolis, Philadelphia, and New York. Paul Wilstach, in his book *Mount Vernon*, tells us: "If the trip were made without Mrs. Washington or her grandchildren he generally pushed forward with secretary and servants and five horses, or at most with the light coachee and outriders. But with his family he traveled with chariot and four or six horses, coachman and postilions, secretaries on horseback, a light baggage wagon, perhaps a two-horse phaeton, and from six to twelve servants. There were usually as many as sixteen horses in the train." When the trip extended to Philadelphia, and conditions *en route* were favorable, the journey would take from four to five days. Let it be emphasized that the roads at that period in the country's development were apt to become difficult to negotiate in wet weather, and the roads in Virginia were no better than they were elsewhere along the traveled routes. The road northward from Mount Vernon came to an end on the Virginia bank of the Potomac just a little way above where the Arlington Memorial Bridge now crosses the river—this bridge being a link in the memorial highway. Where the old road halted, Col. George Mason, an eminent statesman and a friend of Washington's, maintained a ferry; and in this way the Potomac was crossed at Georgetown where the road went onward to a ford on Rock Creek and thence to Bladensburg and northward.

Well-nigh at every turn, then, the Mount Vernon Memorial Highway will have reminders of that vastly important formative period of the nation in which George Washington played in spite of his retiring disposition an outstandingly great part.

Surveyors at work running the line for the Mount Vernon Memorial Highway.

Assembling the framework of a chair in one operation with the ingenious pneumatic clamp.

Compressed Air Saves Money in Furniture Factory

LOS ANGELES was a city of but little more than 50,000 population in the early "nineties" when an enterprising manufacturer began the making of furniture there for local consumption. Now Los Angeles is a municipality of 1,250,000 inhabitants with 176 furniture factories employing 7,064 men; and last year those plants produced $32,899,685 worth of merchandise. This is sold not only throughout the West but in Hawaii, and it even finds a market in the eastern part of the United States.

What makes that California city, so young in manufacturing years, a successful furniture center? How can it compete in volume and design with Grand Rapids and Chicago? To begin with, in keeping with its climate and topography, Southern California has evolved a distinctive type of architecture—tending towards the Mediterranean—necessitating a distinctive kind of furniture. Manufacturers in the East cannot meet this demand, since they must produce for the nation, without creating individual styles for any one section. But Los Angeles factories, being right on the ground, were quick to develop furniture to match the homes and to produce Italian, Spanish, and early California designs that would harmonize with the various types of architecture.

The residents that have settled in California in the past 30 years have provided a good market for furniture. Many of those people came from places thousands of miles distant—too far away to bring with them their household goods. They built new dwellings and furnished them. The established furniture factories were kept busy supplying the local needs, and new plants started up.

To type, character, design, and construction—the four basic requirements of all good furniture, the California manufacturers have added price, as the factories in the Southwest have succeeded in developing quality merchandise at a moderate cost. This has been done through quantity production and economies brought about by the introduction of labor-saving machinery. Brown-Saltman Upholstering Company, of Los Angeles, is a typical example of increased output following the installation of new ways and means. Chief among the modern equipment now in use in its plant is an air clamp for fastening together the framework of davenports and chairs. This pneumatic clamp has raised the factory's production 80 per cent!

The company in question began operations in 1923, when Sidney Brown and David Saltman decided to go into a business of their own. They had little money, but much ambition and some sales experience in home furnishings. Their first shop was a tiny upstairs place, and the proprietors were the only employees. But they had chosen a favorable time to embark in furniture-making. Building activity in southern California was at a peak in 1923, and new furniture was in demand. With business on the up-grade, the partners developed their trade to such a point that they needed fifteen employees at the expiration of six months. In 1925 they moved to larger quarters affording 13,000 square feet of floor space.

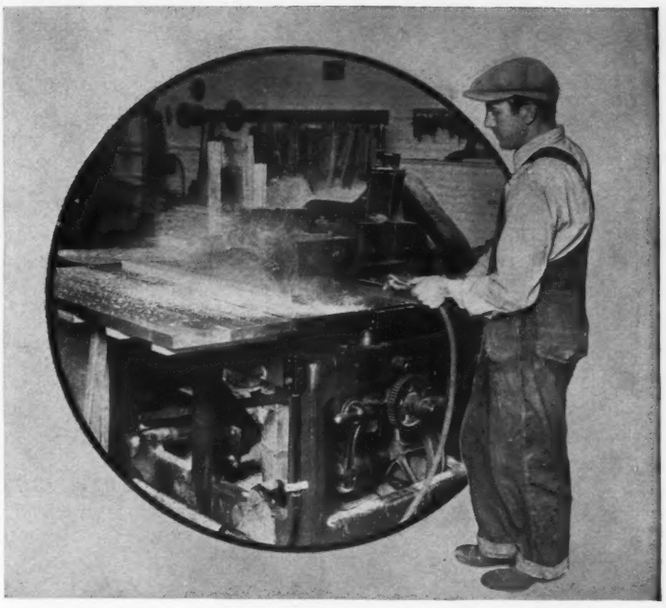
However, the line that they made was expensive. Everything was hand finished. About three years ago sales began falling off, and it was harder to get volume on high-priced sets. The factory had to do something to stimulate its trade, or even to hold its own against competition. Less expensive merchandise and increased production was the solution.

It was then decided to experiment with the

making of popular-priced furniture, and during the first month of the venture $60,000 worth of business was transacted. This test proved that the popular demand was for a medium-priced article. Consequently, Brown-Saltman, in 1929, took over a building with 119,000 square feet of space and began manufacturing on a factory basis. In this plant the products are made from start to finish: the quantities of raw materials delivered there emerge as furniture ready for the market. Nothing but 3-piece living-room suites—a Chesterfield and two chairs—are turned out. As a result of this specialization volume is obtained; and by confining itself to a popular-priced line the company increased its business from a yearly average of $300,000 to $1,000,000 when everyone else was feeling the depression.

One of the aids in this scheme of quantity production is a pneumatic clamp that enables two operators to handle 75 pieces in one hour. Formerly it took an hour and a quarter to put one set together. The idea of this new machine was conceived by the plant foreman who has had 25 years of experience in furniture-making. As explained by the originator, M. C. Anderson, "To secure volume and to cut costs we needed some device to increase production, and it seemed to me that too much time was spent in the construction of single pieces. The ordinary assembling clamp for use in the furniture factory saves just one-half of the labor involved with the hand clamp; but it was my opinion that a machine could be devised that would put the whole frame together in one operation. I made a sketch of such a machine and turned it over to a local shop to see what it could rig up for us. The result of our combined efforts is the air clamp we now have in service.

"With us, the machine has been very successful. Two men are required to feed it—one man gluing the pieces together and handing the frame to the air-clamp operator. Two men can thus do the work that was formerly done by seven men. We could turn out half again as much furniture as we are at present if the market were ready for it." Besides its use in clamping, compressed air has a very definite place in the furniture factory. Jets of air serve to keep the equipment clean—being especially helpful in blowing away sawdust when the self-feeding rip saws and the multiple boring machines are in operation.



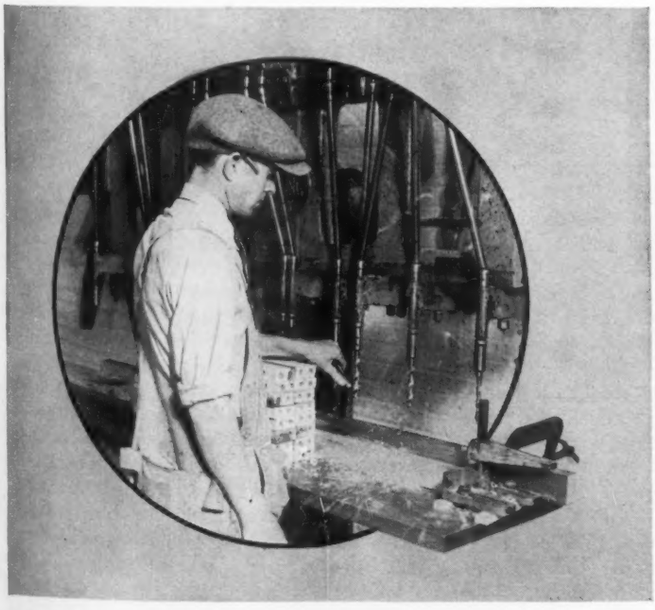
Jets of compressed air help the rip-saw operator to keep his work free from sawdust.

By reason of manufacturing economies and quantity production, brought about by the pneumatic clamp, Brown-Saltman is now in a position to put out a better product for half the price charged heretofore and has been able to invade a much wider field, shipping in large quantities to Washington, Oregon, Idaho, Montana, Utah, and Texas.

DEPARTURE IN HOIST INDICATORS

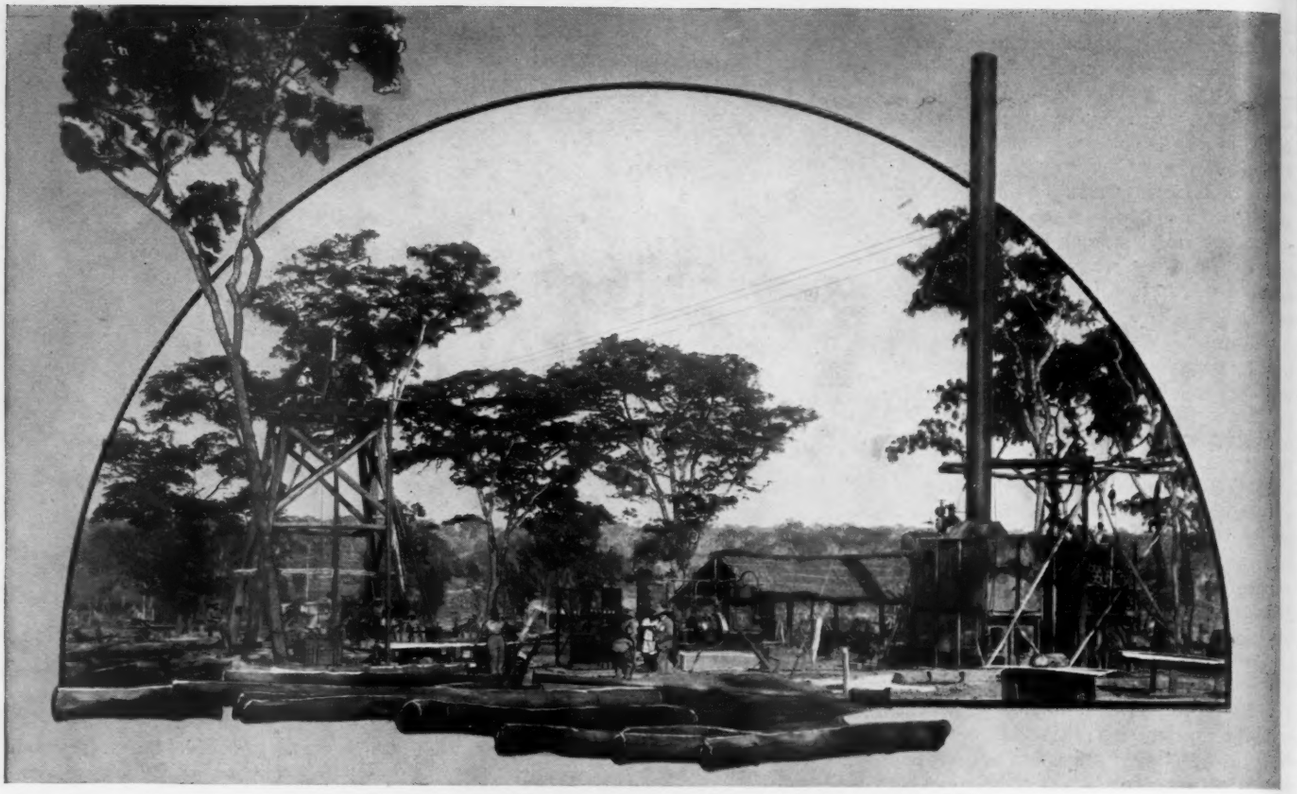
THE firm of Siemens & Halske has developed an ingenious electric depth indicator for hoists that had its inception in a German colliery and that, from all accounts, operates satisfactorily. Built into a 2-compartment shaft at various levels are membrane contacts which are acted upon by the air in the shaft—the air being compressed by the cages in rising and descending. Each of the metal membranes is set in a rubber ring, 8 inches in diameter. Above the membrane, in a watertight casing, is a spring contact that can be adjusted from the outside by means of a screw. The casing terminates in a funnel about 2 feet long. This funnel protects the membrane and serves as a wind trap. When a cage passes one of these members the center of the membrane is forced inward slightly, thus closing the associate spring contact.

The device was tried out for several months under service conditions. For the purpose, five contacts were placed in the up shaft and five in the down shaft at depths ranging between 164 and 820 feet. As the cages travel up and down, the indicator lamps in the hoist room are successively lighted, giving visible evidence at all times of the positions of the cages. Conversely, if the lamps do not function properly, the hoistman knows that it is either a sign of rope slip or faulty coupling between the depth indicator and the hoist. It is claimed that the depth indicator operated effectually at cage speeds as low as 13 feet per second, being accurate to within a few fractions of an inch.



At the multiple boring machine compressed air is a convenient means of removing chips.

Work has been begun on the development of national standard specifications for leather belting that will make it possible before long to purchase on a scientific basis the $30,000,000 worth of belting required annually by American industry to drive machinery. The technical committee that has been appointed to draw up the specifications is made up of representatives of manufacturers, distributors, users, and Government departments. It has been estimated that the general adoption of national standards might result in savings aggregating several million dollars each year.



Headworks of the main vertical shaft at the N'Changa copper mines.

Copper Mines of South Africa

By OWEN LETCHER

PART I

MUCH has been written in recent years about the copper deposits of South Africa, but it is doubtful if the average person is aware of their true extent or of the steps that have been taken to exploit them. Within one fairly small area which extends across the border between the Belgian Congo and Northern Rhodesia, in the central portion of the continent, are known ores which are estimated to contain 21,000,000 tons of copper. Based on an annual consumption equal to that of the peak year 1929, they would supply world requirements for 10½ years.

Not only are the ores extensive, but they are richer than most of the copper deposits in other sections of the world. They average from 4 to 7 per cent metal. In view of these facts, it is inevitable that South Africa will assume a place of importance in the copper-mining industry as soon as production gets underway on a large scale.

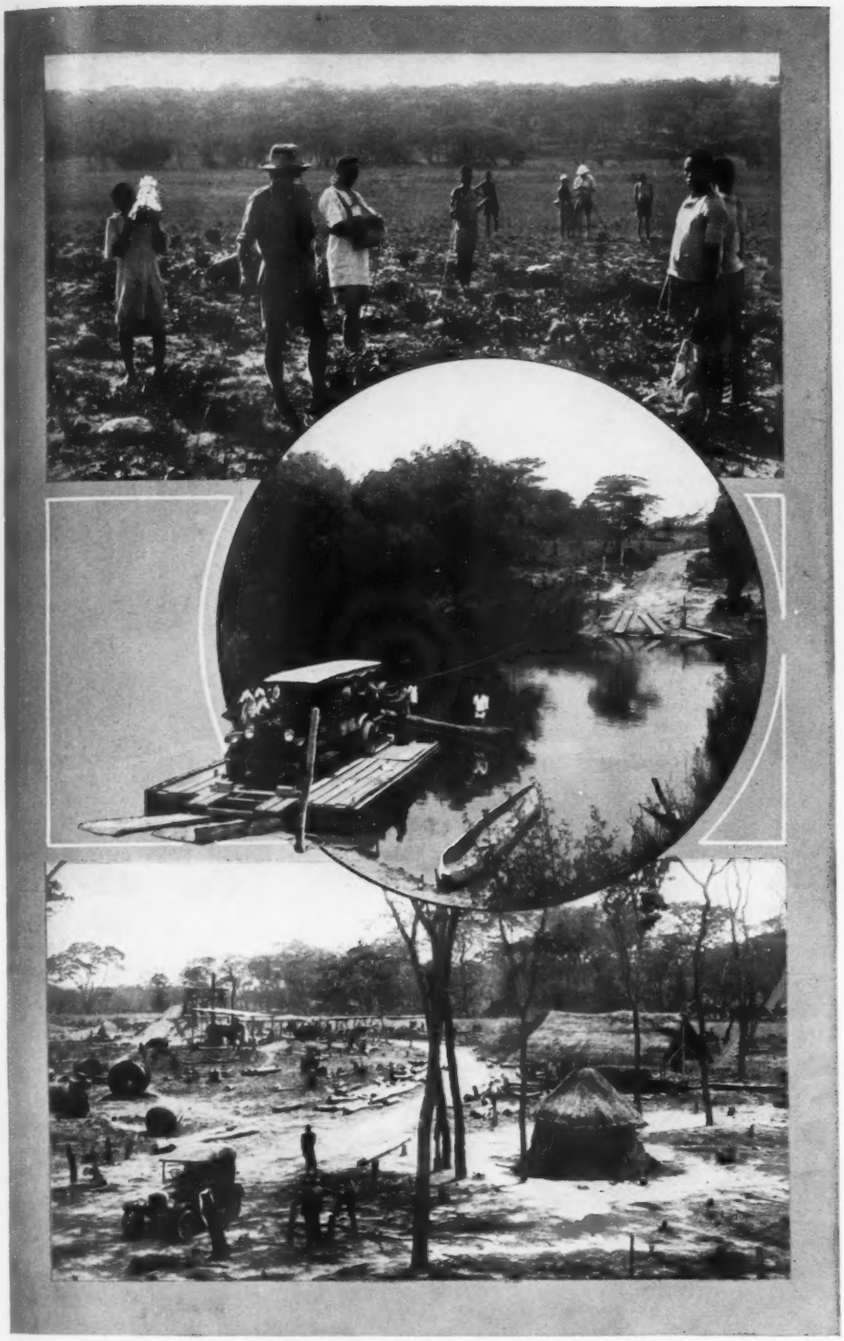
Production costs, which have been relatively high in the past, will be materially lower as time goes on. The ores lie at shallow depth and extend for many miles, making their mining simple and inexpensive. They are not of a complex nature metallurgically; and refining charges will be reasonable. Only for their isolation—they lie 1,200 miles from the seaboard—they would long ago have become an important factor in the world copper market. As matters stand now, the chief things that are in progress and that must be completed before large-scale production begins are the provision of equipment, the blocking out of ore reserves, the training of native labor, the improvement of sanitary conditions, the setting up of houses and structures and the financing of all these.

The area under consideration contains two principal copper-bearing belts: That situated on the Belgian side of the Congo-Zambesi watershed where the Union Miniere du Haut Katanga, a Brussels company in which British capital is interested, has been operating for 25 years, and an immense zone just south of the first-mentioned but across the border line in Northern Rhodesia. There it is that the greatest program of development is in progress. Most of this field is within the N'Kana Concession, but its western extension is under the Rhodesian Congo Border Concession in which American and British capital is invested. There are other cupriferous areas in Northern Rhodesia, notably the Kansanshi field, the North Charterland Concession, and deposits near Lunsenfwa and in the hook of the Kafue River. The two areas named last are idle now because of the depressed copper market.

At the time material for this article was assembled, the only important copper producers were the various Union Miniere properties in the Belgian Congo, and the Bwana M'Kubwa Mine in Northern Rhodesia. Meanwhile, development work was in progress at half a dozen large properties where equipment was being installed to mine and to refine thousands of tons of ore a day. Some of these will be ready for operation during the closing months of this year; but, in view of the low ebb of the copper market, it is problematical just when they will be opened up to capacity.

The principal barrier to large-scale production—the lack of direct transportation routes to the seaboard, has now been removed. There is a direct line not only to the Atlantic port of Lobito Bay but also to the Wankie collieries, far to the south in Matabeleland, which are the only large source of good-grade coal known at this time. Meanwhile a hydro-electric plant has been built on the Lufira River to supply power to the mines of one large company, and another plant is projected for the Lunsenfwa River to serve additional properties.

The importance of the provision of direct railroad connections with the seaboard can be gaged from the fact that up to the present time 50 per cent of the Union Miniere's working costs have consisted of transportation charges. Even with a 1,200-mile haul to the seaboard, it will be possible to deliver copper at European ports at a cost that will permit competition with other world copper pro-



Top—Electrical prospecting in the copper fields of Northern Rhodesia. Center—Crossing the Kafue River which traverses the great copper belt of Northern Rhodesia. Bottom—Opening up a mine in the Congo copper fields.

ducers. If the African deposits were situated on or near the cost, they would by reason of their grade and size be in such a favorable position that few other copper-producing districts would be able to compete with them.

The subject of transportation is of such vital importance, and the building of railroads in such a country constitutes so great an enterprise, that the construction of the Lobito Bay route into the copper fields is a logical part of any general discussion of South African copper mining. This route was initiated by Sir Robert Williams in 1902. Many difficulties of a political, a financial, and an engineering nature had to be surmounted. During the war period, and for several years afterwards, the work was at a standstill. But eventually Sir Robert's indomitable courage and foresight overcame all obstacles; and in the late spring of this year the final section of the line was completed. Sir Robert, a Scotch mining engineer who was a colleague of Cecil Rhodes at Kimberley, has been the outstanding figure among the many men who have had a hand in opening up South Central Africa's mineral wealth for the trade and commerce of the civilized world. It was he who dispatched the original expedition which found the Katanga copper mines in 1899. It was he who, working in conjunction with King Leopold of the Belgians, secured their development. Finally, it is he who has carried through the Lobito Bay Railroad against heavy odds. Future historians, in writing the story of African development, will undoubtedly link the names of Rhodes and Williams as the great pioneers of the movement.

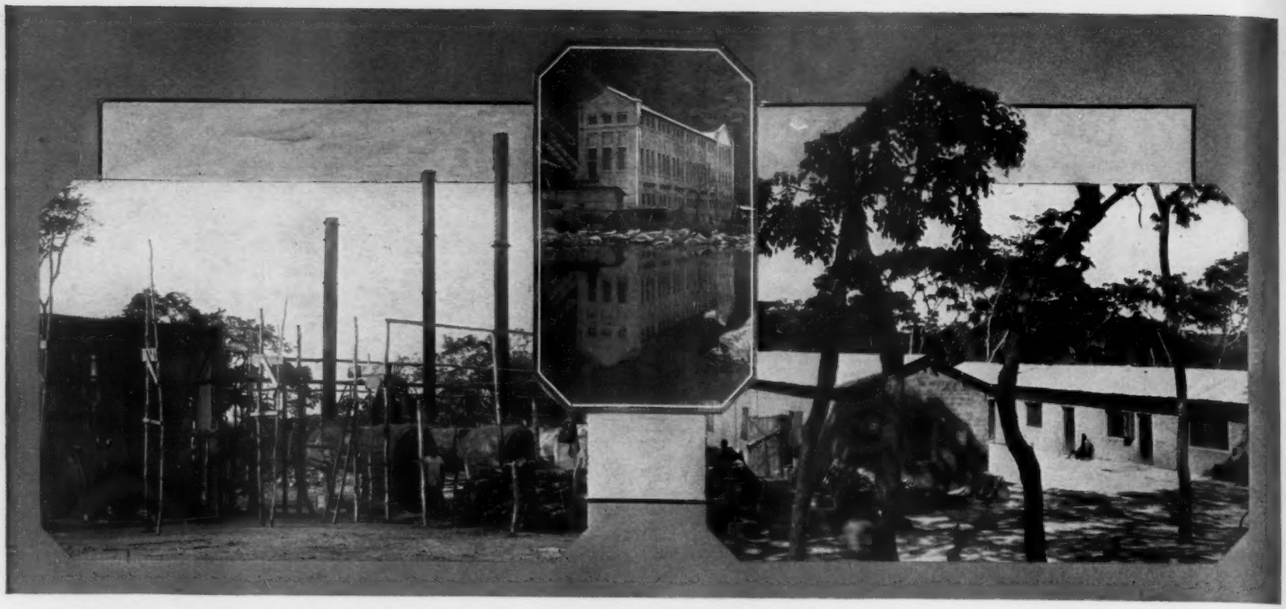
Outcrops of oxidized copper ores were known to the natives of the Congo-Zambesi watershed country long before the advent of white men. Traces of open-cave and shallow underground workings and the remains of crude furnaces have been found in several places. There is nothing to indicate by whom they were formed, or when. However, the smelting of malachite, obtained close to the surface, is still being carried on at some places in the Belgian Congo, and copper ingots in the form of crosses—*les croisettes de cuivre*—are used by the natives as a form of currency. These *croisettes* are bartered in many villages and trading stores. Thus, while the Union Miniere produces and refines huge tonnages of metal by the most modern methods, an old African potentate defies the acquisitive progress of the European and continues to mine and market his copper as his father and grandfathers did for years before him. South Central Africa is full of such paradoxes. Airplanes fly over areas where cannibalism and witchcraft still are practiced, and modern motor cars speed through forests where barbarism reigns.

The opening chapters of the history of African copper mining are obscured by the mists of time, but it is certain that the Portuguese knew of the mines of Garranjanja, as Katanga was then called. But it was not until the Pombeiros, itinerant traders, crossed Africa early in the nineteenth century and saw the "greenstones" of copper that definite knowledge of the deposits reached the outside world.

Although many explorers and traders saw the outcroppings in the years that intervened, no move to open them up was made until 1899, when the Robert Williams Expedition, led by George Grey, pegged claims on land that became the Kansanshi Mine at a point where old workings, in parallel runs, indicated the presence of a series of vertical veins. These occurrences were pointed out to Grey by Kapiri Mpanga, a native chieftain who still lives in the section. Tanganyika Concessions, a British company, was then organized to carry on mining and prospecting operations. As a result of its activities, the Union Miniere du Haut Katanga was formed in 1906 to exploit the entire copper zone of the upper Katanga.

The copper belt of Katanga is roughly 185 miles long and varies in width from 30 to 60 miles. All told, approximately 150 minerals occur there, the most important ones being copper, cobalt, lead, uranium, radium, gold, iron, manganese, coal, and tin. With the exceptions of manganese, tin, and gold, all of them are being exploited, but attention is concentrated on the extraction of copper, cobalt, and the radio-active minerals.

Active exploitation of copper in this area dates from 1910, when the final link in the railroad connecting Elisabethville with the transportation system of Southern Rhodesia



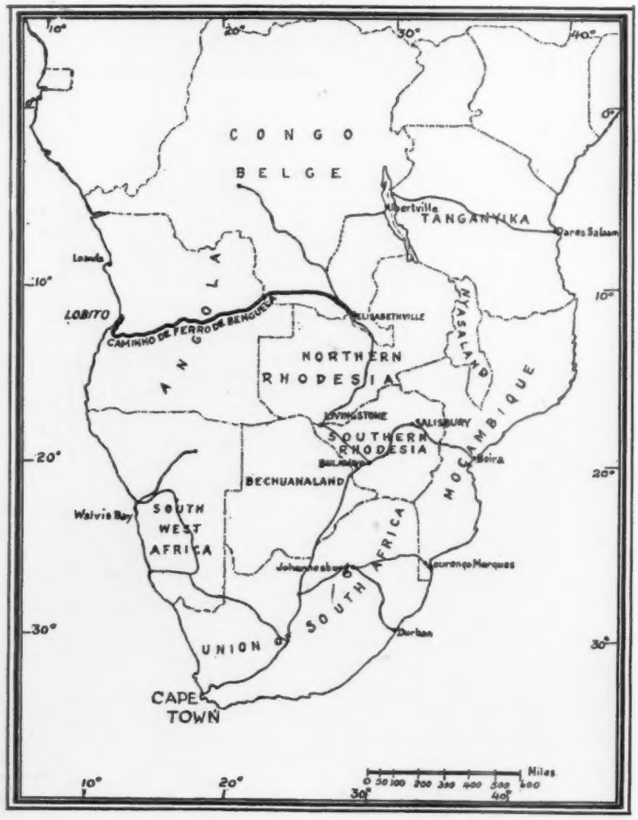
Left—Temporary power plant on one of the properties of the Rhodesian Congo Border Concession. Center—The hydro-electric station that supplies power to the mines of the Union Miniere du Haut Katanga. Right—Stores and offices of the Rhodesian Congo Border Concession.

and the Union of South Africa was opened. Immediately afterwards mining started at the Etoile Mine—"The Star of the Congo"—near Elisabethville. This property was operated steadily until 1926, when its richer ores had been worked out. This mine and the Kambove, situated twenty miles from Panda, were for a number of years responsible for the bulk of the copper production of the Katanga. In 1922 the Ruashi Mine was opened in the vicinity of the Etoile, and in 1926 the Kipushi, subsequently renamed the Prince Leopold, began producing. The latter has proved to be one of the highest grade mining propositions in the world. Some of its sulphide ores are so rich that they are sent directly to Belgium for smelting.

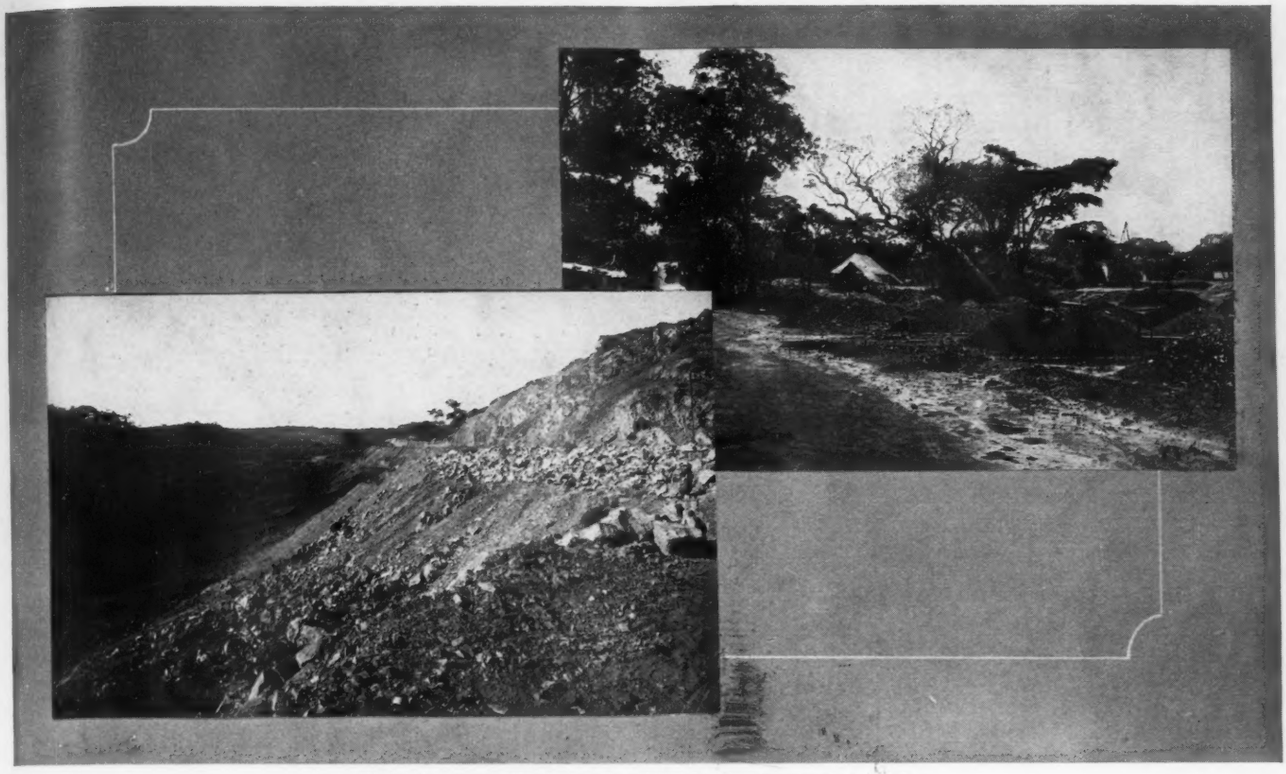
Three or four years after the discovery of the Kansanshi Mine in Katanga by the Robert Williams Expedition, a prospector named Collier found the Bwana M'Kubwa deposit in Northern Rhodesia. A bold malachite outcrop stood up in a *kopje* or hillock which rose above the level of the surrounding country. Collier also found the Roan Antelope deposit about twenty miles west of the first strike. It was marked by a lane or clearing in a forest, which is often an indication of mineralization in this section of Africa. Claims were located there, but nothing was done towards their development for many years.

Sometime afterwards, the N'-Kana Mine was located by Mr. Moffatt-Thomson—now senior native commissioner for Northern Rhodesia—while on an official journey in his then capacity as magistrate or representative of the Chartered Company of N'Dola. Thomson knew little of mines or minerals; but when his natives directed his attention to certain green stones and stainings, he recognized them as evidences of copper ores. He pegged the claims, but subsequently sold them for $500. After several transfers in ownership they reached the hands of the present holders, the Bwana M'Kubwa Company. Initial operations there were disappointing, there being no hint that rich ores lay beneath the lean surface showings.

In 1922, P. K. Horner, an American mining engineer who had been general manager of the Union Miniere du Haut Katanga, decided that Northern Rhodesia was fruitful ground for more intensive prospecting than had been done. A syndicate backed by London and New York capital was formed, and prospecting went actively forward. It may be explained here that the primary reason for the delay in discovering the deposits in this section was due to the difficulties of prospecting. The country is a vast one, and distances between settlements are great. Outcrops are generally concealed beneath deep overburdens, and the surface is usually densely overgrown with trees and other vegetation. Surface ores divulge little information as to the values at deeper levels, and it is ordinarily necessary to prospect below groundwater level. Under these circumstances, deposits can be found and developed only at considerable expense. It is because of these things that no comprehensive scheme of prospecting or development was launched until the system of granting exclusive prospecting rights was initiated in 1923.



Without detailing the manifold steps that had to be taken to find and to open up the various properties which are now under development something should be said of the nature of the ores and their occurrence before the present status of operations is briefly set forth. The ores of Katanga are invariably associated with folds and faults. The productive horizon occupies the lowest stratigraphical position in the sequence of sedimentary rocks of the Katanga system. The folds take the form of anticlines, and the mineral-bearing rocks have been exposed along the lines of re-



Sites of prospective copper mines in South Central Africa.

verse faults. With the exception of the Prince Leopold Mine, where rich sulphide ore is being mined, only oxidized ores are being worked in the properties of the Union Miniere. New sulphide zones, however, are being developed.

The chief minerals of the oxidation zone—malachite and chrysocolla—are distributed in dolomites and shales principally in the form of crust along planes of cleavage and schistosity. Here and there they penetrate the body of the rocks. Accumulations of mineral, in the form of globular masses or stalactites in the cavities, occur in the limestones and dolomites and are sometimes of great dimensions. The oxidized ores are unusually rich in copper: so much so that ores running less than 6 per cent in metal content are classed as low grade. The average copper content of the smelting ores ranges from 6 to 25 per cent, and in some places reaches as high as 40 per cent. Cobalt accompanies copper in all the Katanga deposits.

On the Rhodesian side of the watershed the ores occur chiefly in synclinal basins or troughs. The largest of these is the Mufulira syncline, which follows the Rhodesian-Congo boundary for a distance of about 70 miles. The Bwana M'Kubwa and Mufulira mines are located near its two ends. Southwest of the large syncline are a number of similar smaller basins, and it is in these that the Roan Antelope, N'Kana, N'Changa, and other mines are located. Geological mapping and exploration work is continually extending the limits of the productive areas, which will, in all probability, reveal further deposits when the surface overburden is penetrated by additional pits, borings, etc.

The principal features of the Rhodesian deposits and the points that distinguish them from the Congo deposits are: The predominance of sulphide ores as compared to oxidized ores; the concentration of copper ores in definite ore bodies of more or less uniform thickness over considerable distances, which gives them an appearance of bedded deposits or, in some instances, of elongated lenses; uniform distribution of copper values; and strong evidence, at outcrops and in upper levels, of the leaching of the metalliferous content.

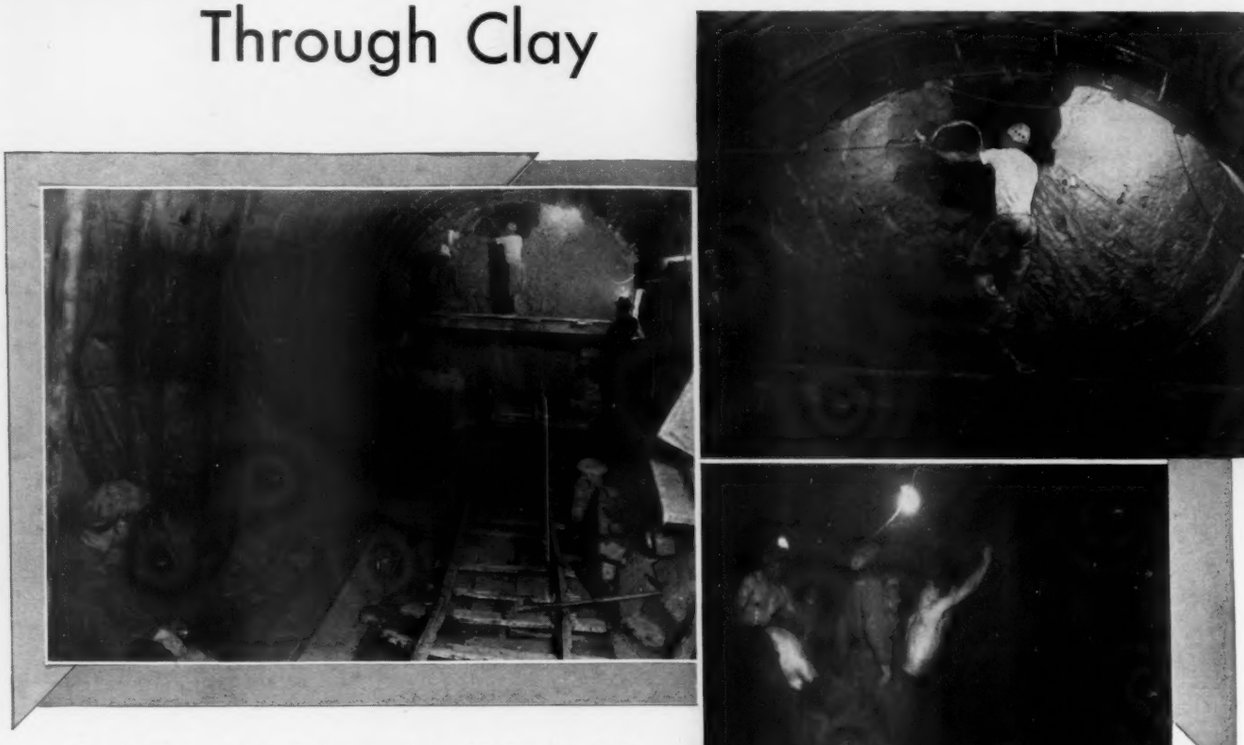
Natives clearing a giant outcrop in the copper country.

Most of the present production is carried on through open-pit workings. The important exception is at the Prince Leopold Mine, where the sulphide ores at the lower horizons are secured through deep mining practice. Steam and electric shovels are used in the pits for loading ore directly into railroad cars that deliver it to the plants.

(To be concluded)

Compressed air has been substituted for steam used in the Loon Lake Copper-Silver Mine to operate pumps that keep the 500-foot level dry. The change was urged in order to improve the underground working conditions.

Draw-Knife Method Used to Tunnel Through Clay



Several views of tunneling operations with the clay knife. The air hoist that draws the knife is seen in lower corner of picture at left.

By J. W. GREEN

A RATHER ingenious method of advancing a tunnel heading through clay is being used at Detroit by the Dravo Contracting Company of Pittsburgh. It is enabling three miners and eleven laborers to make much more progress per shift than they otherwise could.

The work is being done on one section of a tunnel system that will carry water to Detroit and surrounding territory from Lake St. Clair, one of the minor members of the Great Lakes chain. The section in point consists of approximately 1,600 feet of tunnel of circular cross section varying from 14 feet to 18 feet in diameter before lining. The material through which it passes is a plastic clay of such consistency that it holds together well, being neither soft enough to run nor hard enough to be brittle. The tunnel is being driven at a depth of about 60 feet in water-bearing ground, calling for air pressures ranging around 27 pounds.

Ordinarily, pneumatic clay diggers are employed in such ground. This method is highly efficient as compared to excavating by hand, and has been used with success in various parts of the world for a number of years. However, it requires one mucker to each miner. The clay-knife method, consequently, not only materially reduces the labor cost but it is also conducive to netting more work per man by allowing each more room in which to move about.

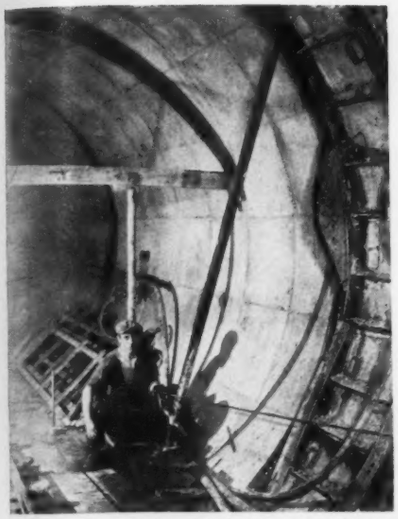
The scheme consists of cutting strips of clay off the walls by means of a knife attached to a cable and pulled through the material by an air-motor hoist. One of the accompanying illustrations shows the form of the knife improvised on the job and made up in the required number in the contractor's blacksmith shop. It consists of a loop of iron, 20 inches long and 12 inches wide, with a cutting edge on one half and the other half finished round to provide a grip for the operator. Riveted to the center of each side of the loop and mounted perpendicularly to the plane of the loop are pulling arms made from one piece of metal and tapering to an eye for attaching the cable.

The manner in which the knife is used can best be explained by describing the operations involved in advancing a typical section of the tunnel. Assume that the breast—a flat wall of clay—is 15 feet in diameter. A miner, using an Ingersoll-Rand No. 73 pneumatic digger fitted with a spade, first excavates a 3x2-foot pilot tunnel at the top and center of the heading. This pilot tunnel is always kept a full day's drive in advance of the main heading, or anywhere from 12 to 18 feet, depending upon the character of the material encountered.

This pilot bore serves to give the knife a surface against which to start cutting and also discloses the nature of the ground to be removed by the knife. The miner, working on a platform placed across the tunnel, attaches the knife to the cable and inserts it in the pilot hole as far as he can conveniently reach. He presses it into the side of the wall, and the hoist then pulls it back, cutting off a strip or "dog" of the clay. The motive power is supplied by an air hoist of either the EU or 10-H Type, both of which are employed. Concreting of the tunnel closely follows excavating, and the hoist is stationed at a point back in the finished section. The hoist is mounted on a wood block on a plank base. The weight of the operator sitting on this plank and the pressure of a vertical brace or pipe jack from the tunnel top serve jointly to hold the hoist securely in position and at the same time permit it to be quickly moved to a new set-up when necessary.

The initial operation of the second miner is to bell out the pilot bore to the side and top lines of the large tunnel. He works only in the upper 6 feet of the cross section, however, creating a bench that runs the full length of the day's drive. From this bench he can readily reach the top of the arch and trim it to size.

After this top heading is excavated the work of taking out the bench begins. As a starting step, the third miner digs a groove or trench across the bench at a point close to the heading or the end of the day's drive. This groove, about 6 inches wide and 6 inches deep, is cut with a hand trenching spade. The purpose



Concrete section of the tunnel close to the working area, showing the hoist mounted on timber skids.

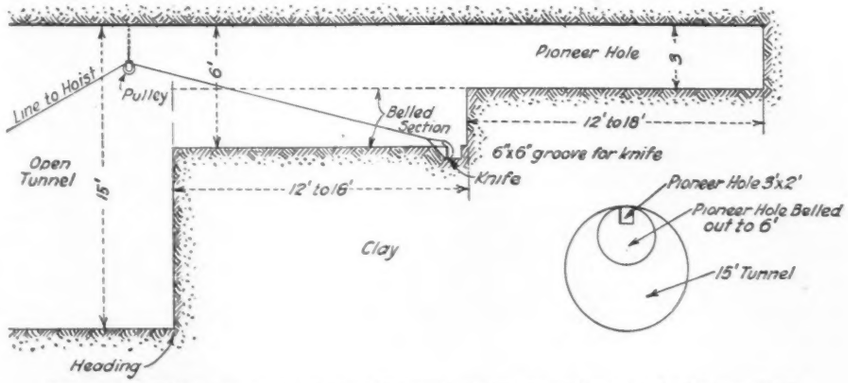
of this depression is to give the knife a fair face to start against. Accordingly, the trench is maintained as the bench is removed. This means that the knife cuts through the full 12 to 18 feet of clay at a sweep. The miner follows it during its travel through the clay, holding it in position by the pressure of his hands.

As the strip comes off, one of the muckers cuts it with a hand spade into sections 12 or 15 inches long. These sections are then loaded by hand into cars for disposal. The three miners—one driving the pilot hole, the second belling it out, and the third stripping down the bench—keep eleven muckers busy cutting and loading the clay. One reason for the efficiency of the knife method on this particular job is the plasticity of the clay. If it were softer or harder it probably would not be possible to obtain such satisfactory results.

It is also well to bear in mind that the length of the day's drive is contingent upon the character of the material encountered, because the time the clay will remain in position without movement varies with its plasticity and the overburden. In the Detroit district it has been found most economical to drive and to place the concrete lining complete within 24 hours. The work for the 24-hour period is planned as follows: removing clay, twelve hours; concreting, eight hours; setting up forms, cleaning up, and moving tracks forward, four hours.

Compressed-air equipment is put to another application on this job that is of recognized value and bids fair to become common practice. The concrete tunnel lining is placed by the use of collapsible steel forms; and to insure the complete filling of the intervening spaces these forms are vibrated while the work of concrete-placing is in progress. This is done by means of a pneumatic sand rammer equipped especially for the purpose with a rubber butt and a grip handle. Air for all the requirements is supplied by three Ingersoll-Rand belt-driven stationary compressors.

The Dravo Contracting Company is driving the tunnel under contract, its bid price being $583,530. When completed, this tunnel, together with other tunnel sections, filtration plants, pumping stations, etc., will augment Detroit's water supply sufficiently to meet all anticipated needs until 1950. By that time it is expected that a tunnel will have been driven far to the north to tap Lake Huron.



Sketch showing progressive steps in excavating tunnel by the knife method.

FLOOD CONTROL IN SEINE VALLEY

WORK has been started in the upper Valley of the Seine, France, on a series of reservoirs that are of more than uncommon interest because they are designed to perform a number of important services. Their primary purpose is that of flood control—to protect the City of Paris against the havoc so frequently caused in the past by the rising waters of the Seine. Secondarily, they are to restore water to that river during periods of drought; to furnish water for the generation of electricity; and, possibly, to increase the water supply of Paris.

The plans call for eight artificial lakes on the Cure and the Chalaux rivers in the Morvan Mountains. Two of them are now in course of construction at the junction of those streams. They will cover a combined area of 800 acres and will have a total capacity of 1,183,019,000 cubic feet. A rock tunnel is to connect one of these reservoirs with a power house to be reared at a point on the Cure where the water has a drop of 328 feet.

The reservoirs now building are in the nature of an experiment, as it is believed in some quarters that the quantity of water thus to be diverted, though large in itself, will amount to but a small proportion of the volume that at times flows through the Seine Valley. During dry seasons, on the other hand, the release of waters so impounded should, it is conceded, be of benefit. At such times the flow through Paris has been known to drop to 1,236 second-feet, a condition that is apt to interfere with the navigation of the stream should the city require more than her normal water supply of 742 second-feet.

Close-up of the clay knife and the pneumatic rammer that was fitted for use as a vibrator.

Whether or not the scheme will be carried through to its projected climax will depend entirely upon the showing made by the two reservoirs now being constructed.

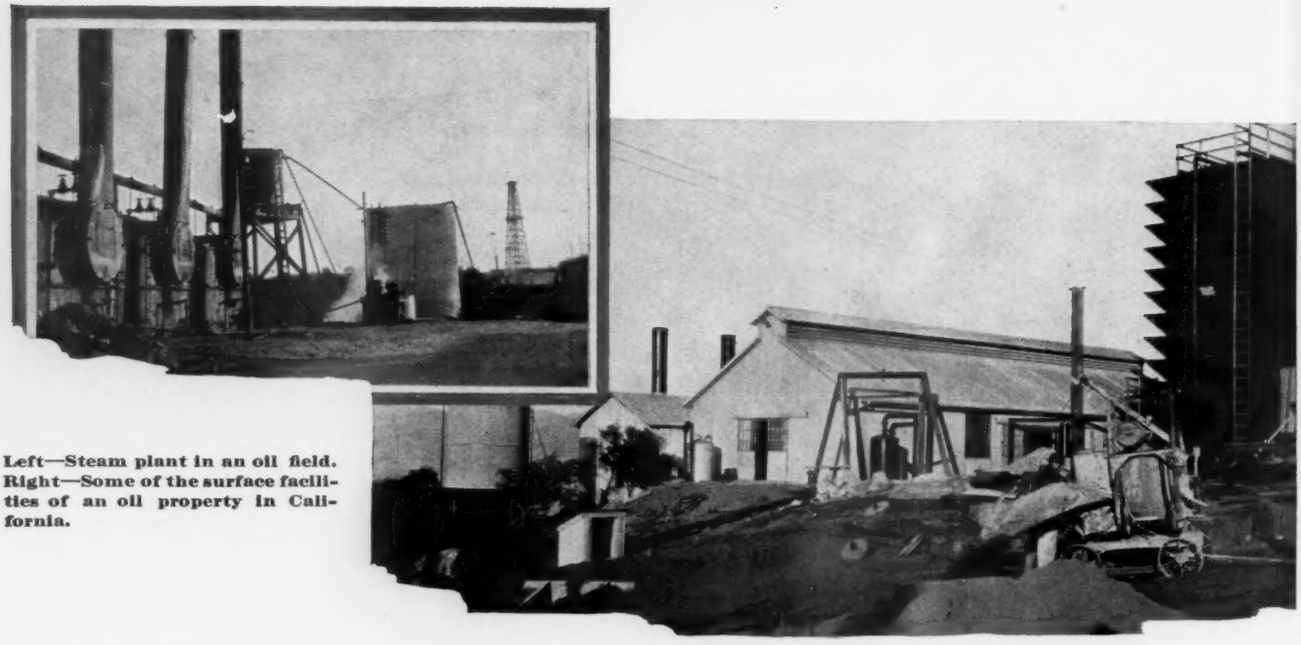
RADIOTELEGRAPH SERVICE ON AIRPLANES

EARLY in February was inaugurated in Europe the first plane-to-station commercial radiotelegraph service. The Deutsche Luft Hansa, in coöperation with air-transport companies of Czechoslovakia and Austria, as well as the respective postal authorities, has made arrangements whereby ordinary telegrams not exceeding fifteen words may be dispatched from the airships on the route Berlin-Dresden-Prague-Vienna for delivery to any point in the three countries concerned.

Telegram blanks are to be found on the planes; and the messages are radioed, as need be, to the stations of the Central Office for Safety in Aeronautics in Berlin and Dresden or to stations in Prague and Vienna. Thence the messages are transmitted to their destinations by wire, bearing a notification to that effect and that they were sent from a plane in flight.

Since its inception, the service has been extended to include the Berlin-Vienna express airway—the plan being gradually to embrace within the system all the lines operated by those companies. It is expected that the present rate of one Mark per word, about 24 cents, will be substantially reduced as the service expands.

The population of Canada is officially estimated to be 9,796,800, an increase of more than 1,000,000 in a decade



Left—Steam plant in an oil field. Right—Some of the surface facilities of an oil property in California.

Oil-Field Portable Compressors Meet Varied Demands

By C. O. WORK

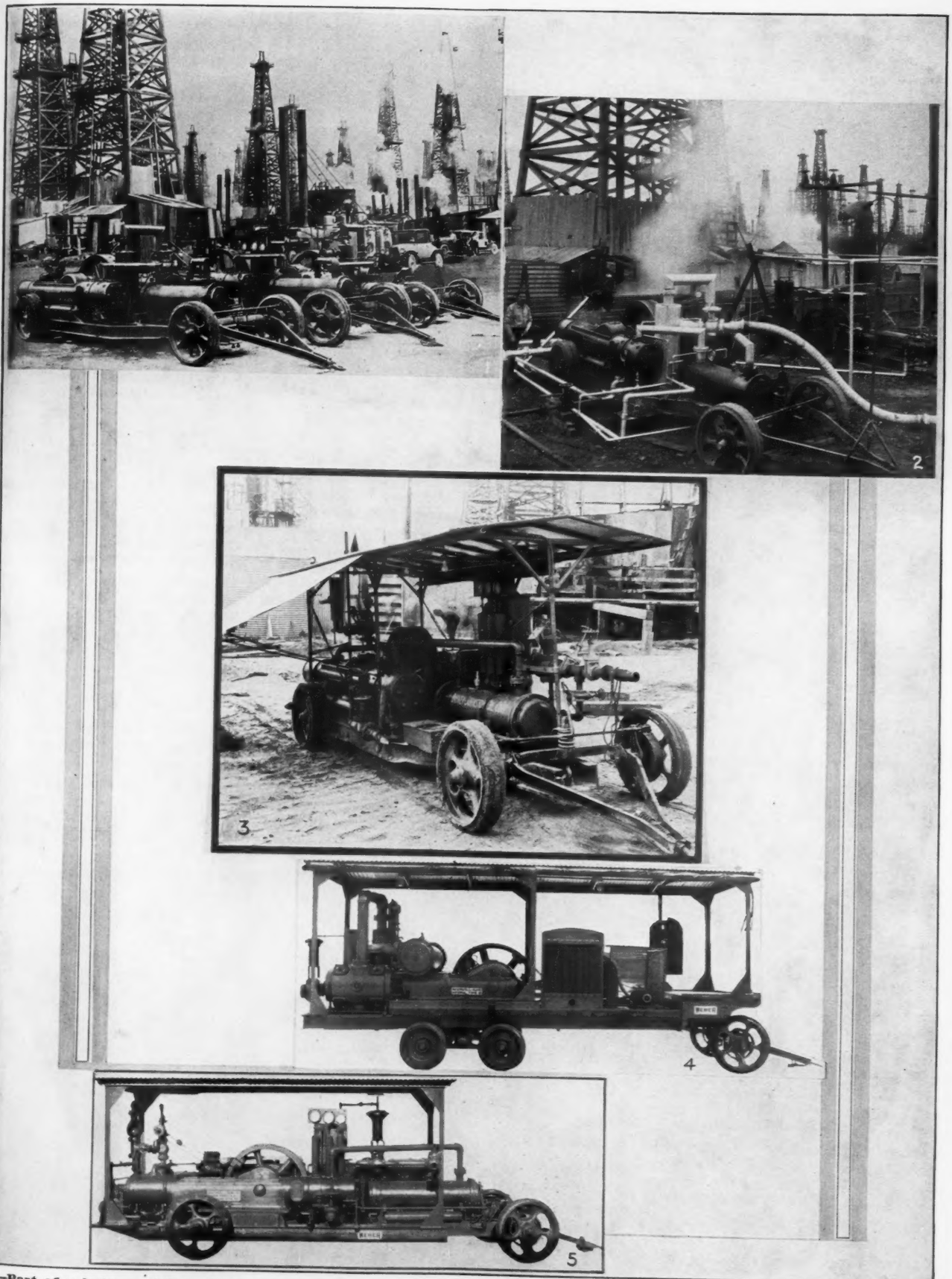
GAS in an oil-bearing formation is commonly the primary force that drives the petroleum through the sand to the vent offered by a well. An abundance of gas at a considerable pressure is usually responsible for the flush period of a well. When the supply of gas and the pressure diminish, the output of oil either drops or ceases. Therefore, when nature fails, man must do something to provide a substitute that will serve to continue the movement surfaceward of the desired oil. What he does depends upon the conditions confronting him.

When the fall in gas pressure is gradual and the day of failure can be foretold with reasonable accuracy, it is possible for the field engineer to take corrective steps more or less deliberately. On the other hand, if the drop in pressure be sudden and unexpected, then he must make haste and bring to his aid apparatus that can be put to service promptly. Experience has shown him that the portable compressor is the least costly and the most effective agency in recreating pressure by artificial means. He cannot wait to build a foundation for a stationary type of compressor. Time is precious, and every hour counts because any loss in production may be of considerable volume and represent a substantial sacrifice in dollars. In such an emergency a portable compressor may save the situation; and if successful in this work it will pay for itself handsomely.

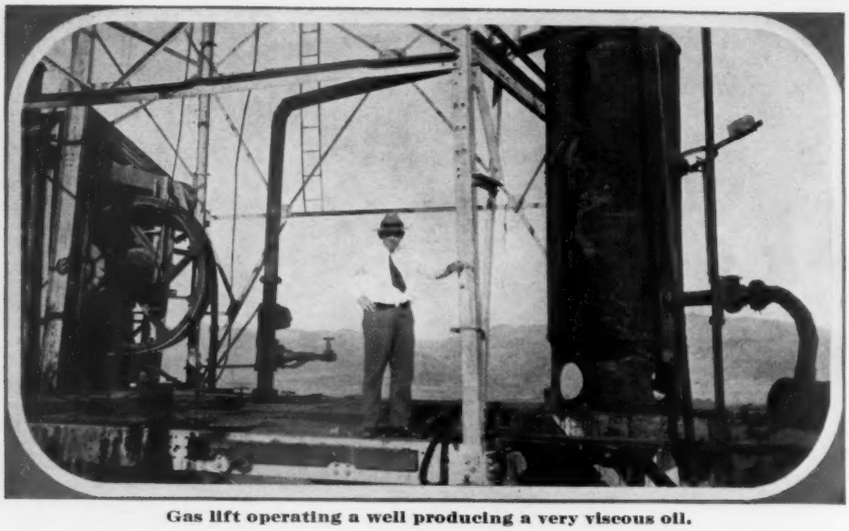
The foregoing problem is only one of several that may confront the engineer. He may find himself called upon to furnish an additional volume of compressed gas to make up a shortage in a well's gas pressure; again, there may be need for a means of making a repressuring test by what is known as the "side-spotting system"; and in another case a way must be found either to boost gas through a fuel line to a distant point or to bring up the capacity of a stationary compressor plant that has become unexpectedly incapable of doing its accustomed work owing to the development of mechanical difficulties of one sort or another. In all these contingencies the portable compressor has proved time and time again both efficient and effectual. The mobility of the portable compressor is its outstanding virtue—other factors being equal so far as a comparison may be made with a stationary machine of identical capacity.

Vista of the rugged country in the Cat Canyon field of California.

Only the man familiar with oil-field conditions, especially when the field is in open or sparsely settled country, can quite appreciate the significance of the term mobility. In many of these regions roads are all too few, and the term highway is far too complimentary. In normal service, these roads answer fairly well for the people living in the section and using them only occasionally,



1—Part of a battery of Type XPVR compressors used by L. R. Knowlton to test oil wells for their adaptability to gas lift. 2—This XR-2 steam-driven gas compressor brought in an oil well 7,000 feet deep and made it profitably productive. 3—Steam-driven Ingersoll-Rand gas compressor used by the Dabney-Johnson Oil Corporation in testing formation pressures of oil wells and in cleaning them. 4—Type of gas compressor, on trailer mount, equipped with electric drive. 5—Steam-driven gas compressor mounted on a trailer to facilitate transportation in California oil fields.



Gas lift operating a well producing a very viscous oil.

but they commonly fail when subjected to heavy traffic and called upon to bear the ponderous loads that have to be moved in transporting equipment for pumping rigs, steam plants, derricks, pipe lines, etc. In dry weather, these roads are knee-deep or more in dust, and in wet weather they are soon turned into mud axle-deep and with ruts for the wheels which leave ridges between them upon which laden vehicles are apt to be anchored.

Despite the foregoing handicaps, equipment and miscellaneous materials must be hauled into the field; and it is with a full knowledge of the physical difficulties that are likely to be encountered that oil-field portables have been devised. The wheels are given broad treads and are grouped where the heaviest load comes so that there will be ample bearing surface for the burden. The outfits are provided with fairly long wheel bases for the purpose of giving the units sufficient springiness and length to facilitate travel over bad roads and rough country, and they must have enough clearance to meet the conditions that are likely to develop in transit. Not only that, but it is indispensable that they be equipped with brakes that will surely hold them on steep hills. Furthermore, the frame on which the compressor and associate apparatus are mounted must be so stable that it will survive the stresses set up when underway; and the frame must also be such that it will constitute a firm foundation for the compressor when operating. Manifestly, sturdiness is a characteristic of the first importance.

It should be self-evident that portable compressors constructed for service in this exacting field are quite unlike the portable compressors employed to advantage in many other directions. According to R. H. Pence, an experienced oil-field engineer, the type of compressor equipment devised to meet the varied and decidedly rigorous conditions just enumerated has answered very well; and for field-blowing needs a relatively small outfit fills the requirements. Such a mobile plant is compact and will operate at speeds in excess of 200 revolutions a minute. A compressor of this sort can be mounted on a trailer; and the complete assembly can be made well within the weight and the dimensional clearances prescribed by the State.

Compressors of this description have, commonly, ample capacity to handle something like 500,000 to 750,000 cubic feet of gas daily at an operating pressure ranging from 200 to 800 pounds. At times they may be expected to run for short periods under a discharge pressure well above 1,000 pounds—the demand occasionally approaching 1,500 pounds. Steam is usually the motive force for these compressors; but machines belt driven by electric motors have been employed, and a number of them are now in service and performing satisfactorily.

The up-to-date trailer compressor unit is a decidedly complete outfit, and has everything essential to its proper operation. A pump furnishes water to cool the cylinder jackets, and there is a gas intercooler between the two stages of compression. Water connections are provided which facilitate the making of quick and serviceable hook-ups with a water supply or a cooling basin. On the outfits with electric drive it is common practice to mount a radiator to cool the circulating water, and this makes outside water connections unnecessary. It is usual to furnish an intake gas scrubber that can be counted upon adequately to remove any foreign matter that may be carried by the incoming gas. This precaution safeguards the compressor from any trouble that might originate in that way. The incoming gas is regulated so as to maintain a given pressure at the compressor intake; and, of course, all valves essential for the control of the equipment are provided.

In addition to the foregoing features, these oil-field portables have pressure gages that are fitted with surge chambers that steady the needles and thus insure the correct indicating of pressures. Below the intercooler there is ordinarily installed a condensate chamber, and this has proved very helpful in maintaining the efficient operation of this important apparatus. To insure perfect control of the high-pressure discharge gas line, that line is equipped with high-pressure gates and relief valves. All piping is simple and as complete as the service demands; and the arrangement is such as to permit easy drainage and the removal of scale.

How, someone will ask, are these mobile compressor outfits sheltered from the weather? This protection, so Mr. Pence tells us, consists of a modern, sturdily built metal roof; and in addition to this there are side awnings to keep out the rain and to shield the machine from the mists so often present in oil fields. Because these compressors may be required to operate continuously night and day for many days it is usual to equip them with electric lights. A plug-in socket with flexible electric cable connections is furnished so that a quick hook-up can be made with any nearby source of lighting current.

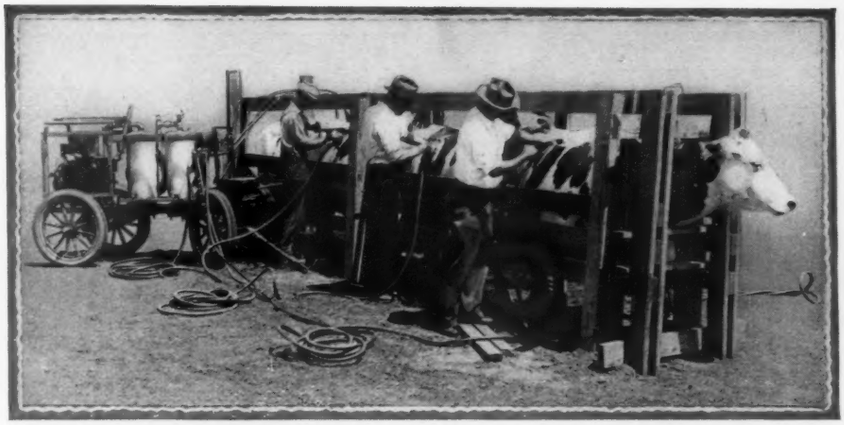
When at work in the field, compressors of this trailer type are usually mounted on timbers embedded in the ground, with a "dead man" and a turnbuckle on each end. In this way it has been found possible to reduce vibration to a minimum; and it is a matter of surprise how really good and consistent the performance of one of these outfits will be in such circumstances.

While there are departures in some respects from the design of the mounted compressor just described, nevertheless the main difference

An oil field in California worked exclusively by means of the gas lift.

consists in adapting a much lighter compressor capable of discharging gas at a pressure close to 2,000 pounds. Mounted units of this sort are usually single stage and commonly work in conjunction with the machines already mentioned. These lighter compressors are employed only occasionally, but they are of value in that they make it possible to meet the higher pressures that are encountered at times.

Anyone familiar with oil-field work, the character of the country so often found in the vicinity of oil fields, and the diversity of demands imposed upon equipment when an emergency arises, will readily grasp how helpful mobile compressor outfits of the kind dealt with are likely to prove. This is merely confirmation of the value of mobility so amply demonstrated in many other directions in which the portable compressor has become a recognized essential part of the operating plant. This same mobility lends itself to time saving and to marked economies.



The vacuum machine doing effective work on a cattle ranch at Lamar, Colo.

VACUUM MACHINE REMOVES PEST FROM CATTLE

THE housewife, with her motorized sweeper, has nothing on the up-to-date farmer, for that gentleman has been provided with a newly invented vacuum cleaner with which to extract ox warble parasites from the backs of his bovine stock. The ox warble is an insect pest that lays its eggs on the hides of cattle. Upon hatching, the young grubs burrow under the skin and gorge themselves on blood until nearing maturity, when they crawl out. The grubs irritate the creatures so that they do not thrive as they should nor, in the case of cows, yield their normal measure of milk. They work further injury by puncturing holes in the hides, making them just that much less desirable for leather. Indeed, for certain purposes—such as belting, soles, etc., sections of the hides so damaged are generally rejected. The little pest has, therefore, brought untold losses to cattlemen throughout the country.

Since the ox warble first attracted nationwide attention many years ago, the farmer has, until of late, had but one means of ridding an infested animal of the grubs. That method consisted of applying pressure with the hands and squeezing them out. This, as may well be imagined, was a slow and tedious procedure.

Two years ago, Drs. Marion Imes and Z. C. Boyd, resourceful livestock parasitologists of the United States Department of Agriculture, invented a vacuum machine that removes the grubs by suction and "in the twinkling of an eye". The machine is mounted on a trailer pulled by an automobile; and in giving it its tryout in Illinois and Colorado, the experimenters drove it around from farm to farm treating the suffering animals. While the cost of this first apparatus was rather high, the inventors consider it practicable for coöperative countywide use.

A South African, it is claimed, has taken the flicker out of movies by the invention of a machine that projects a continuously moving film with a direct and constant beam of light.

Photos, courtesy U. S. Dept. Agriculture

Close-up of the nozzle of the machine invented by Government experts for the removal of ox warble grubs from the backs of cattle.

SPECIAL TRUCK COLLECTS COAL SAMPLES FOR ANALYSIS

THE United States Bureau of Mines, in its work of studying the characteristics of coals from different fields, analyzes approximately 1,000 samples monthly. This is a big task; and the actual taking of the specimens is not the smallest part thereof. To simplify this phase of the operations there has lately been put in service by the bureau an automobile truck especially equipped to collect the samples for subsequent examination.

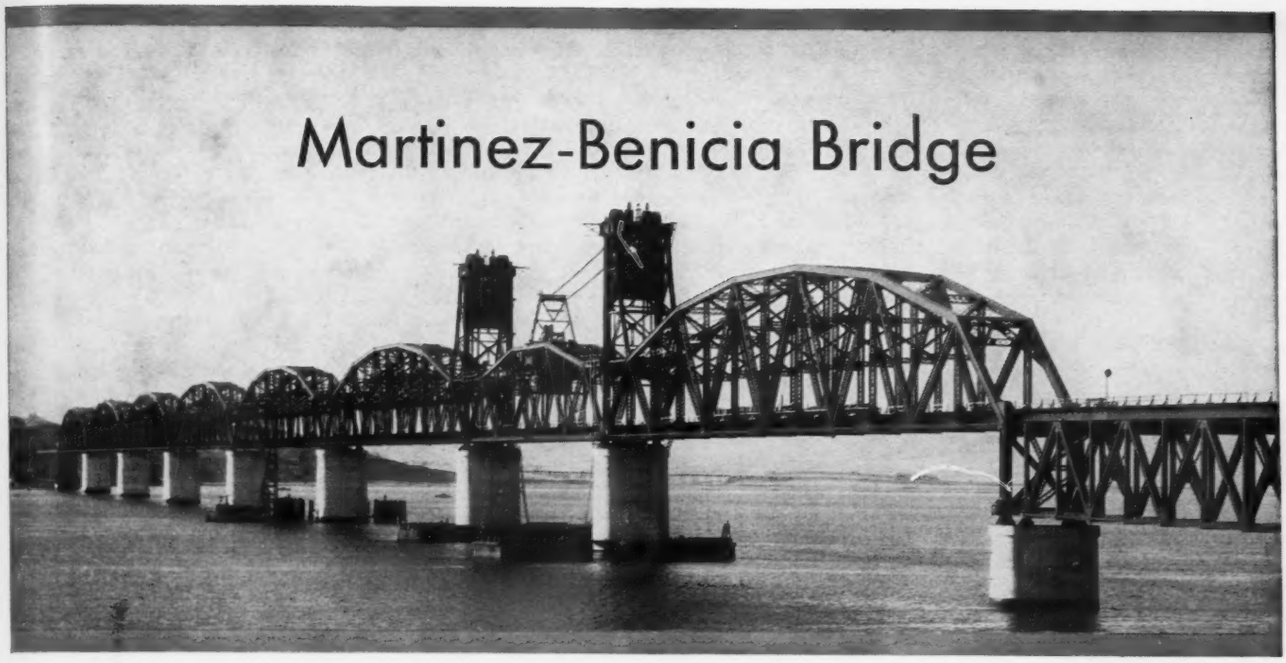
Mounted on the truck and directly connected to a 4-cylinder gasoline-engine power unit is a swing-hammer type of crusher which reduces the coal to a size that will pass ¼-inch mesh. From the crusher the coal passes through a riffle that separates it into two equal parts—the first step in cutting down the 1,000-pound sample taken from the tipple to the 5 pounds required for the tests. After each sample the crusher and the riffle are cleaned so that no trace of coal is left in them to contaminate the next sample. This cleaning is done with compressed air, which is supplied by a small compressor also mounted on the truck and driven by the aforementioned power unit.

Before the introduction of the coal-sampling truck the crushing was done by hand, and the equipment used was shipped by rail or otherwise transported. Now the crushing is done mechanically, and no time is lost in moving from mine to mine. As compared with the older method, it is possible to make ready for the laboratory in a given time just twice as many samples as heretofore and to do this at little if any increase in cost.

In May of this year the Bethlehem Steel Corporation and the Carnegie Steel Company began rolling rail sections weighing 152 pounds, 22 pounds heavier than the sections now in common use. The rails are for the Pennsylvania Railroad, and are designed for axle loads of 100,000 pounds at speeds of 100 miles per hour. The maximum capacity of the 130-pound rail is 80,000 pounds at 80 miles an hour. The addition of one pound of metal per yard has resulted in an increase in strength of 22 per cent, according to an official of the railroad.

Close-up of the bridge structure discloses a maze of steelwork that is designed to give essential strength under all service conditions.

Martinez-Benicia Bridge



This Railroad Link Across Suisun Bay is an Outstanding Engineering Triumph

By LAWRENCE A. LUTHER

THE great double-track railway bridge which spans Suisun Bay is outstanding as an engineering achievement and as a link in modern rail transportation on the Pacific Coast. Suisun Bay is one of several arms of San Francisco Bay, and has for years stood in the way of direct rail traffic between points lying to the north, south, and east of it. For more than half a century, the Southern Pacific lines on either side of that body of water have been connected by a train ferry running between Port Costa and Benicia. This served well enough in the days when the San Francisco Bay region was not as populous as it is today. In 1880, the year after the service was inaugurated, the trains carried across Suisun Bay numbered 3,561. In 1925, a total of 12,972 made the crossing, representing an increase in 45 years of 264 per cent. Needless to remark, the traffic has not dropped off in the period that has intervened.

The fact that there was need of a railroad bridge over Suisun Bay had long been recognized by the Southern Pacific Company. Late in the "eighties", and again in 1904, sites for such a structure were considered. The existence, however, of well-established earthquake faults, together with other unfavorable conditions, caused them to be rejected. The survey upon which was based the decision to build the bridge now standing was begun in June of 1927. Diamond-drill tests from Army Point, on the north shore, and Suisun Point, on the south, revealed that rock extended across the channel at varying depths along the proposed route; and geologists, after making microscopic studies of the borings, reached the conclusion that no earthquake faults crossed the zone. Despite those findings, all the piers are designed to resist earthquake vibrations twice the intensity of those that accompanied the San Francisco disaster in 1906; the concrete used for the piers has a compressive strength of 2,500 pounds per square inch and a tensile strength of 400 pounds 28 days after pouring; and for every cubic foot of pier there are 30 pounds of reinforcing steel.

Work on the undertaking was begun on May 3, 1929, when the first shovel of dirt was moved at Suisun Point; and the placing of 21,000 tons of steel in nine truss spans, in the lift span and towers, and in the viaduct approaches was completed in eleven months, which is considered something of a record. On October 15, 1930, the bridge was opened to regular train service, thus signaling the retirement of the ferries *Solano* and *Contra Costa* and greatly speeding up passenger and freight traffic on he local as well as the transcontinental lines between San Francisco and points north and east.

From abutment to abutment, the bridge has a length of 5,603 feet; and it is said to be the longest and the heaviest 2-track bridge west of the Mississippi. It consists of seven 526-foot through truss spans; two deck spans, 264 and 504 feet long, respectively; one 328-foot vertical lift span; and a 560-foot viaduct at the south end and a 220-foot viaduct at the northern terminus. A total of 22,000 tons of steel have gone into the superstructure: 12,500 tons of silicon steel, 6,750 tons of carbon steel, and 2,750 tons of specially heat-treated steel for the eyebars. This weight is supported by ten main piers and 22 pedestal piers, which required the placing of 105,000 cubic yards of concrete and 1,500 tons of reinforcing steel. Just what this means can perhaps be better understood when it is known that more concrete was poured into any one of the ten main piers than was used in putting up San Francisco's largest skyscraper. The deepest of the piers is 207 feet from bedrock to bridge seat, which is equivalent to the height of a 20-story building.

Ferry "Solano" carrying a train across Suisun Bay for the last time.

The bridge has a clearance at mean high tide of 70 feet, and this enables all but 5 per cent of the craft plying those waters to pass beneath the fixed spans. The 328-foot vertical lift across the deep-water channel can be raised in 90 seconds so as to give a maximum clearance at high tide of 135 feet. The lift is operated by electric motors; but an internal-combustion engine is installed as a standby in case of current failure. As a safety measure, the lifting mechanism is interlocked with track circuit relays so that the span cannot be raised while trains are standing in or approaching either entrance to the bridge.

While the intricacies of signaling or train control may not be of especial interest to the layman, he will no doubt appreciate the working of the positive stop control that regulates

the movement of trains across this bridge. Human fallibility was taken into account in designing the accident-prevention apparatus which is now in service between Oakland and Norden in the Sierras on the Southern Pacific's Overland route. Should an engineer be stricken while at his post, or should a dispatcher fail in some detail in his role of master synchronizer, the safety of the trains is assured by electric nerves and brain cells which send their impulses to magnetically operated emergency valves in the brake-actuating air line.

Large electromagnets are placed between the rails and are charged through relays by the shunting of track circuits by a train moving through or standing in the block or in the zone bounded by the next two automatic signals lying ahead. Indication of the occupancy of the block is given the engineer of the oncoming train by the conventional red light or signal arm But in the event of his failure to stop clear of the signal, his train is given an emergency brake application by the charged magnet which protects the occupied zone. The emergency valve is operated by a device carried beneath the engine tender.

The characteristics which especially recommend this positive stop control for its important task of safeguarding the bridge approaches are its simplicity and its ruggedness. Besides serving in the capacity just described, the electromagnet, through the medium of the interlocking relay, is made to act as a sort of mechanical Horatius because it prevents any train from passing the bridge entrances while the lift is raised or about to be raised. Throughout its full length of more than a mile, the Martinez-Benicia Bridge is designed to carry a load 50 per cent greater than that represented by the trains now running over it.

Engineers who are interested in bridge-building should find ample compensation in studying this great structure. The completion of the entire project in the record time of eighteen months, and the methods that were used in constructing both the piers and the spans combine to give an unusual color of pioneering to the project. The depth of the water, the softness of the mud bottom, and the fluctuation and turbulence of the tides imposed exceptional handicaps.

The deep-water piers presented a difficult problem, as the depth of the water precluded the use of open cofferdams or working under air pressure. The idea of sinking caissons by open well dredging also had to be abandoned. In the language of the Southern Pacific Company, a unique method of pier construction was finally determined upon. This method involved, first, the driving of piles around each pier site and the building of an octagonal-shaped platform on top of the piles. On this platform were then erected eight steel towers containing winches with cables over sheave wheels. By means of this apparatus, a steel shell, that might be compared to a bottomless oil tank 81 feet in diameter, was constructed and allowed to descend through the water into the mud. Depending upon the compactness of the mud, this shell penetrated to a depth of from 15 to 50 feet.

The shell was built up in circular sections 10 feet in height, and each section was bolted to the top of the underlying section and thus gradually lowered into the water. When the bottom of the shell touched the bay bed it was filled with sand dredged from the surrounding waters. The island area of sand thus created within the shell permitted the exact staking out and the fabrication of the steel cutting edge of the caisson that was to be sunk to bedrock. Portable steel forms were erected above the caisson cutting edge and reinforcing steel placed in them. Concrete was then poured in successive lifts of 10 feet. All this work was done above water, and enabled the crews to pour tested concrete of desired quality and strength. It also permitted them to center and to orient the mass as it settled toward bedrock.

One of the divers employed in making frequent inspections during construction of pier foundations.

When the caisson had settled near to bedrock, and after the greater part of the material immediately above bedrock had been removed by hydraulic jetting and clamming, a deep-water diver was sent down to explore the bottom. His inspections made it possible for the engineers to verify the diamond-drill borings and also assured them that the bridge piers would come to rest on bedrock.

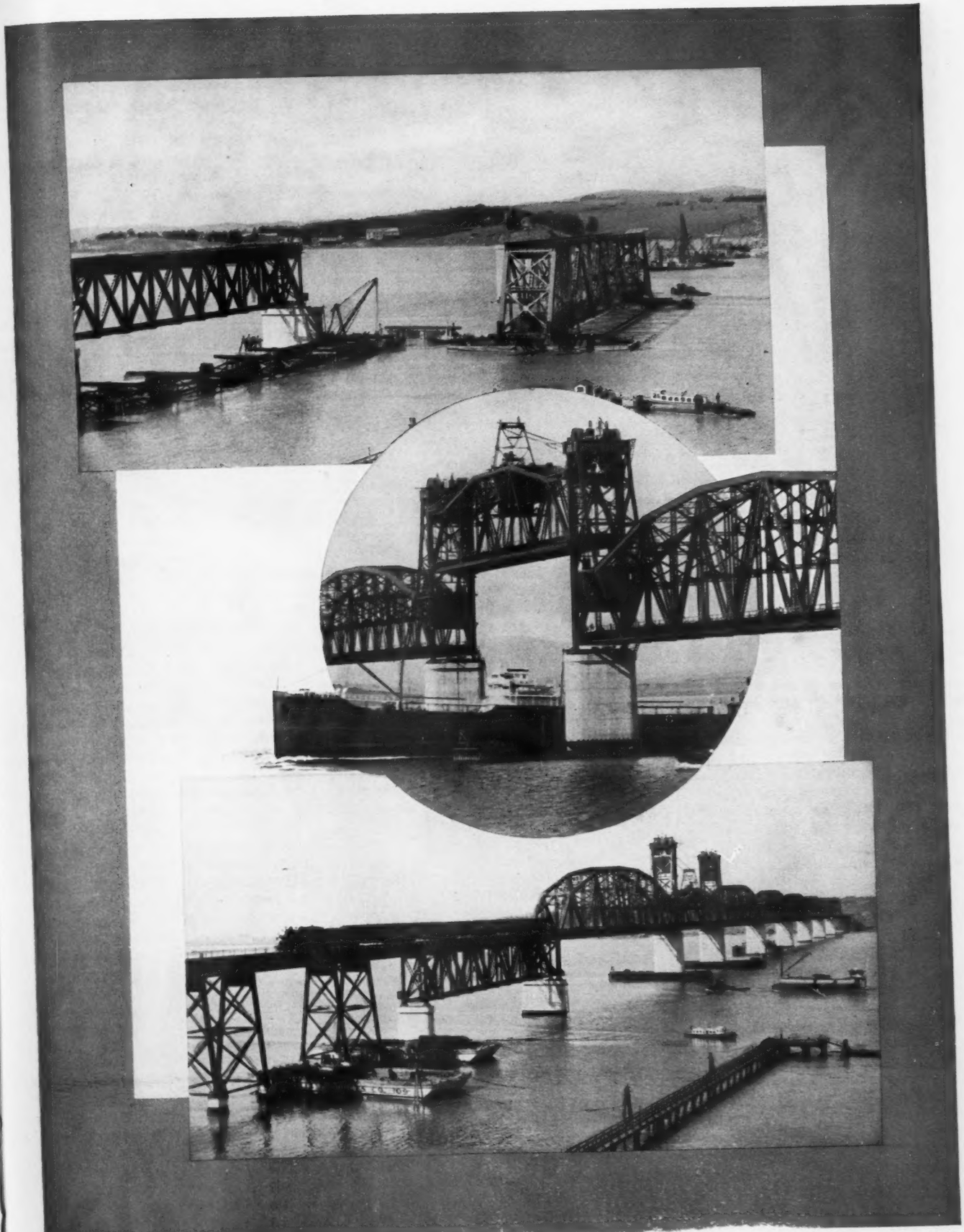
The use of one of the steel spans as a falsework for the erection of all the other spans is another instance of the courage and independence of thought that has characterized the engineering of this undertaking. This 526-foot span was built on piling sunk in the shallow waters at the south end of the bridge; floated on two steel barges from position to position; and successively placed on shoulders purposely given the piers.

The bridge approaches involved the laying of six miles of track. This entailed extensive grading and the construction of a viaduct 1,860 feet long. The track is made up of 110-pound rails, creosoted ties, and the sturdy fittings now standard on the Southern Pacific system; and it has been heavily ballasted with copper smelter slag.

A modern 16-tool pneumatic tie-tamping unit was lately utilized in surfacing this track. This is but one of the many uses made of compressed air in the completion of this great project. Besides drilling, reaming, and riveting in erecting the structural steel, compressed air served as a medium of control during the handling of the falsework span. Pneumatic tools were also helpful in driving the spikes and in tightening the joint bolts in the track.

The building of the Martinez-Benicia Bridge at a cost of $12,000,000 is typical not only of the vast expenditures being made by the country's big trunk lines but is evidence of the very practical economies that the railroad systems are effecting at the same time. For instance, the bridge would probably not have been started when it was if the Southern Pacific Company had not been confronted with the problem either of replacing the two long used car ferries or of continuing to retain them in service at a disproportionately high maintenance cost. The railroad authorities, after due consideration, decided that they would ultimately be able to show a very substantial saving by abandoning the elderly craft and rearing, instead, a thoroughly up-to-date bridge across Suisun Bay.

For the sake of those interested in statistics, let it be recalled that the passenger cars ferried had increased from 72,000 in 1911 to 93,000 in 1926—representing a growth in this phase of traffic of 30 per cent in the course of fifteen years. The number of freight cars handled by the ferries rose from 94,000 in 1911 to 142,000 in 1926—an increase of 52 per cent. The time ordinarily required to float a passenger train across Suisun Bay was 30 minutes. Notwithstanding the greater length of the rail run and the restricted speed imposed, the bridge route saves on an average of 30 minutes even though the difference in time is only ten minutes between that of the train and the ferry under weather conditions



Top—Floating falsework span into position preparatory to erecting first truss span. Center—Lift span elevated for passage of an oil tanker. Bottom—First train crossing the Martinez-Benicia Bridge.

Down in a caisson pouring concrete for one of the big piers.

favorable to the ferry. However, the average gain will be greater the year around because of the frequency of fog which invariably hampers and slows up water-borne traffic.

Freight trains will benefit more by the bridge than passenger trains. When the ferries were in use, freight trains had to be broken up and carried across the bay in successive sections; and a long freight train formerly required about 2½ hours in its ferrying. A freight train can now easily travel the intermediate rail route via the bridge in considerably less than half an hour. One does not have to resort to higher mathematics to ascertain some of the gains in operating economy that the bridge will make possible. In railroading, as in other fields of service, time is another term for money either made or wasted. It is self-evident that it will not take a great while for the Martinez-Benicia Bridge to pay for itself and to begin to return a handsome profit annually.

The construction work was carried on under the direction of C. R. Harding, now assistant to the president of the Southern Pacific Company, and W. H. Kirkbride, engineer of maintenance of way and structures. G. W. Rear, engineer of bridges, and H. I. Benjamin, assistant engineer of bridges, were in charge of the field work; and S. A. Roake, chief designer, planned the foundation and superstructure.

Detroit, America's automobile manufacturing center, is contemplating the expenditure of $7,500,000 for the construction and operation of four underground garages in the heart of the business district. They are to be spacious enough to provide parking space for from 12,000 to 18,000 cars.

POWER AND RAIN FROM THE AIR

THE possibility of harnessing the air to generate power or to create rain in mountainous, tropical regions was recently under discussion at a meeting of scientists in Paris, France. Mr. B. J. Dubos, the father of the scheme, makes the claim, based on years of study, that if a vertical tunnel be anchored to the side of a mountain, the differences in temperature, pressure, and density at the various altitudes would cause to pass through that tube a current of air of sufficient force to drive turbines. If near the sea coast, such a tunnel would draw up from the nearby waters great quantities of moist air that would form clouds throughout a wide radius at the top of the tube. Mr. Dubos has estimated that a tunnel with an aperture at the top of 42.5 feet would eject a cloud mass over an area of 75,000 acres.

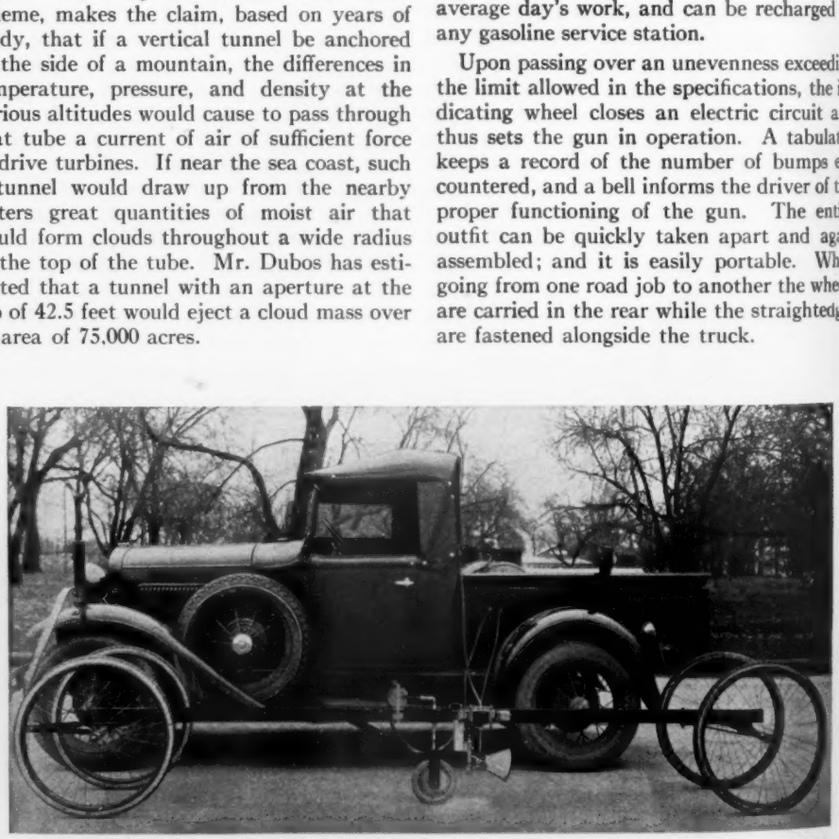
ROAD PROFILOMETER MARKS UNEVEN PLACES

A NEW type of profilometer is now in service in Ohio checking up on the variations in the surfaces of newly laid pavements. Although the Ohio State Highway Department has been using such a machine for the past seven years, the new model is declared to be far more practical and efficient. Since smoothness is essential to good riding, the profilometer was designed to indicate the surface irregularities of new roads so as to make it possible for a contractor to eliminate them before final acceptance of the job.

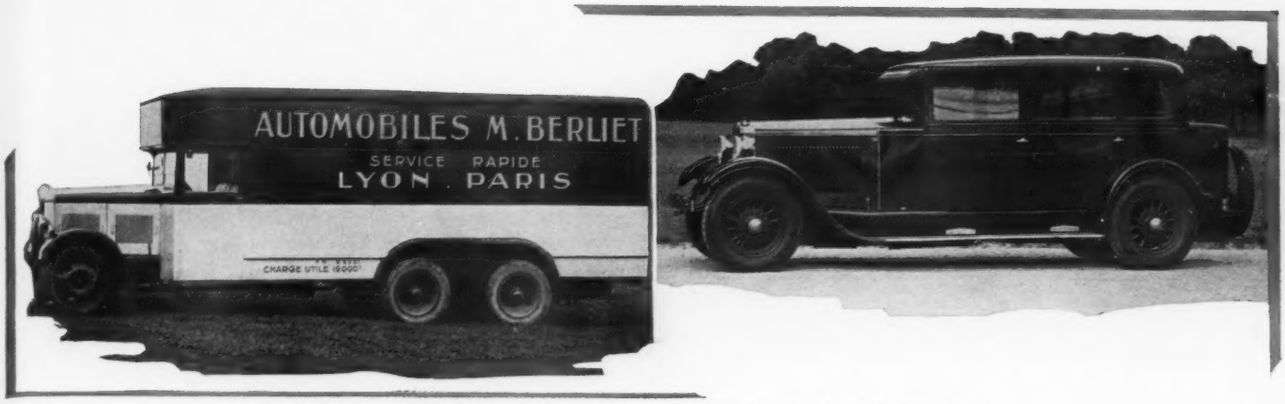
Before describing the equipment now in use it should be mentioned that the original machine weighed 1,600 pounds, was mounted on sixteen wheels, required a 23-foot trailer, and made a written record that had to be checked by an analyst and typed before it was available. The present profilometer weighs but 70 pounds; has four bicycle-type wheels; is attached to the side of a light-weight truck; and gives the contractor an accurate and visible record right on the pavement itself.

Mounted on the wheels is a straightedge either 10 or 18 feet long, depending upon the roadway to be tested. Suspended from the center of the straightedge is a small indicating wheel. The instant this wheel goes over a comparatively high or low place in the pavement, the particular spot is marked with white paint. This is done by a spray gun which draws electricity for its operation from the automobile battery. The necessary compressed air for the gun is taken from a receiver on the truck. This tank contains air enough for an average day's work, and can be recharged at any gasoline service station.

Upon passing over an unevenness exceeding the limit allowed in the specifications, the indicating wheel closes an electric circuit and thus sets the gun in operation. A tabulator keeps a record of the number of bumps encountered, and a bell informs the driver of the proper functioning of the gun. The entire outfit can be quickly taken apart and again assembled; and it is easily portable. When going from one road job to another the wheels are carried in the rear while the straightedges are fastened alongside the truck.



Equipment used by the Ohio State Highway Department to locate and to mark for correction surface irregularities in new roads.



Typical motor truck and passenger car built by the Berliet Company.

Berliet Motor-Vehicle Plant

Some Facts About a French Company That Builds for a Wide Field of Service

By M. CHOSE

THE Venissieux Works of the Société des Automobiles Berliet reflect impressively the manner in which the motor-vehicle manufacturers of France have adopted thoroughly modern methods and equipment. Indeed, it may be truly said that the facilities and the production processes employed in the foremost French plants are in many respects the equal of American establishments engaged in the same field of industry.

The Société des Automobiles Berliet is the outgrowth of a firm founded in 1899 by Marius Berliet; and at that time the shop force consisted of only five workmen. Even so, the enterprise must have been headed in the right direction and ably guided, because only seven years later the firm had built and in operation four shops at Lyons-Monplaisir. In the beginning, the activities of the concern were limited to the making of touring cars; but the output progressively widened out into all branches of the automotive industry.

Like many other engineering concerns, the Berliet Company did much important work in providing munitions, cars, and lorries for service in the national defense during the period of the World War. In 1917 the organization became a limited company; and in order to provide for expansion a tract of land of approximately 1,000 acres was bought in Venissieux, about six miles from Lyons, where was promptly begun the erection of new shops. The buildings of the Venissieux plant have gradually increased in number and in size until, today, the establishment covers about 250 acres of the tract purchased fourteen years ago.

In addition to the manufacture of motor cars of four and six cylinders, the Berliet Works turns out cars and trucks for industrial uses as well as buses for rapid transportation. These vehicles are capable of carrying loads ranging from 1,000 pounds to 25,000 pounds. The diversified nature of the motor vehicles now produced at the Berliet Works, together with their capacities, is ample evidence of the manner in which this capable and energetic concern has gone steadily forward.

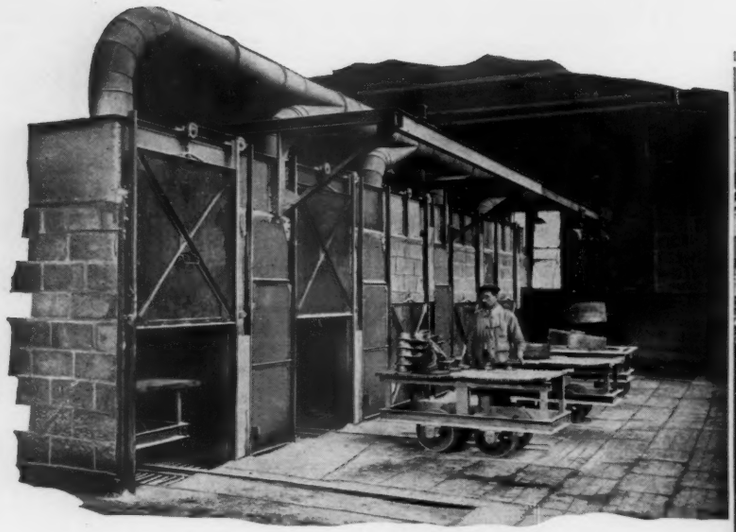
The Berliet Works was one of the first of the French plants to take up in a practical way the problem of finding substitute fuels for the commonly used gasoline; and to this end considerable attention was given to the adaptation of gas producers. In June of 1926 the company's wood-gas producer-type of motor truck made a long-distance record in a race around France. Also, in November of the same year, a lorry of this type crossed northern Africa in a run from Tunis to Casablanca. About the same time a 6-wheel motor vehicle, designed and built by the Berliet Works for the transportation of members of the Chamber of Commerce of Algiers, made a successful trip across the Desert of Sahara—the run including a round trip between Algiers and the Colony of the Niger.

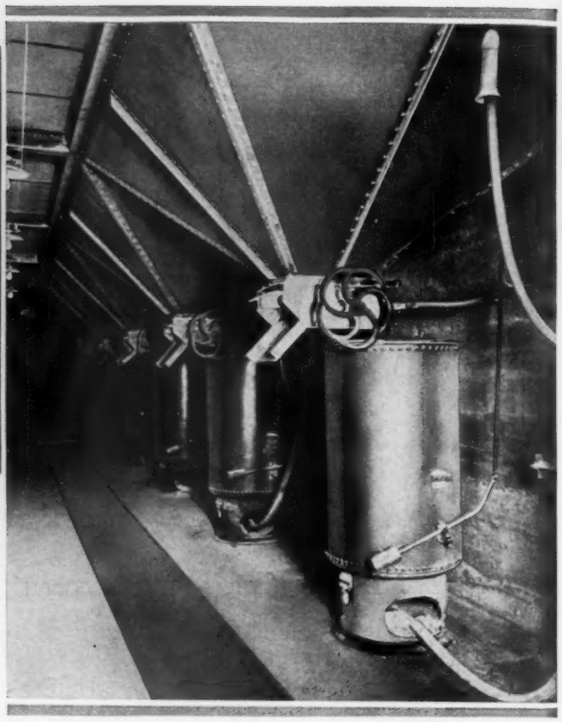
As might be expected, the Berliet Works contains shops that are equipped with the most modern machinery, and these are sufficiently varied to meet every requirement. There is a central air-compressor plant containing a number of Ingersoll-Rand machines calling for the development of nearly 1,000 hp. to drive them. These compressors supply air to the shop lines at a pressure of 90 pounds per square inch; and this air is utilized extensively and for many purposes. Much air is used in the steel and iron foundries to operate molding machines, sand rammers, air hoists, vibrators, core breakers, chipping hammers, and sand-blasting equipment.

Dust-storage hopper discharging spent sand into small tram car.

The plant for the sand-blasting of steel castings is probably the largest single user of compressed air. It was erected not long ago at Venissieux; and it is this part of the works that is of outstanding interest at this time. Some of the principal features of this typically up-to-date department are shown by three of the illustrations accompanying this article.

The plant consists mainly of a series of five sand-blasting chambers arranged in a single line for the sake of convenience and operating economy. The castings, after their removal from the molds, are placed on metal cars and run into the several chambers from one side and, after treatment, are run out





Left—Group of five sand-blasting chambers showing castings from the foundry about to be treated before passing out at the opposite end of the department.

Right—Storage hoppers, with 2-way gates, placed above pressure tanks of the sand-blasting system.

through doors on the opposite side and moved thence directly to the chipping department. By this arrangement the castings follow a flow-sheet course that minimizes as far as practicable any lost motion.

The sand-blasting plant is provided with five riveted pressure tanks, one for each chamber, having a capacity of 1,700 pounds of abrasive and fitted, each, with an automatic filling valve, sand control, etc., etc. These tanks are beneath and in line with the sand-blasting chambers, thus insuring a continuous flow of sand and obviating certain mechanical features that would be apt to occasion trouble.

The floor of each sand-blasting compartment is made up of a metal grid that permits the used sand to drop directly into a storage hopper immediately below. The hopper, in its turn, can discharge into the associate pressure tank located beneath it, as shown by one of the photographs reproduced with this article. At the bottom of each hopper there is a special 2-way gate which, when in one position, feeds good sand into the pressure tank and, when in the second position, allows worn-out sand to drop into a small car spotted so as to receive the descending sand.

The sand-blasting plant is equipped with a positive dust arrester. The arrester is divided into two sealed chambers—a dust chamber and a "cloth pocket" chamber. The dust-laden air first enters the dust chamber where the heavy particles are separated from the light particles by reason of the difference in density. The light-dust-laden air then passes through the fabric in the second chamber—the cloth arresting the fine dust. The air that issues from this compartment is clean. Each of these chambers is provided with a dust storage hopper placed beneath it; and quick-acting gates at the bottoms of the hoppers regulate the flow of dust during the emptying operation. All dust is collected in small cars that also carry it away for final disposal. The dust arrester is equipped with an exhaust fan capable of meeting the requirements as dictated by the screen area of the arrester and the volumetric capacities of the several sand-blasting chambers.

The Venissieux Works make wide use of producer gas; and, to this end, it has three producer-gas plants. One of these outfits furnishes fuel for enameling, drying, etc.; and no inconsiderable part of this gas is utilized in small furnaces and for the shop trials of motors. The second of the producer-gas plants provides fuel for the furnaces used in the heat treatment of steel parts; and the third is the source of fuel for the furnaces in the forge shop. Electric energy totaling 10,000 hp. is required in the different departments of this expansive establishment. The current comes from hydro-electric stations in the Alps.

In addition to automobiles, motor trucks, and passenger buses—some of the latter designed for service in mountainous countries—the Berliet Company builds gasoline-engined tractors of various sorts and for many uses. The enterprise's healthy development is the outcome of wise management and much business foresight.

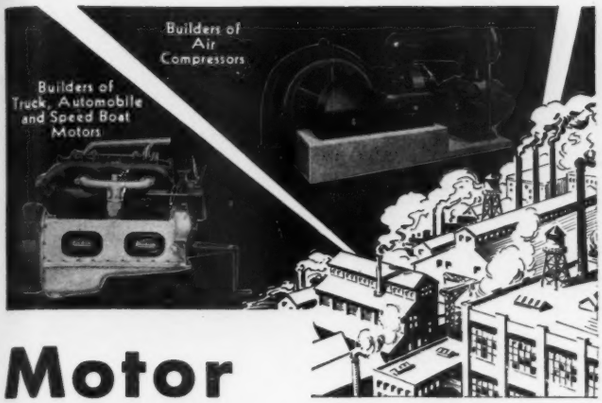
The Southern Railway System has installed a pneumatic conveyor at its New Orleans terminal to facilitate the handling especially of copra from ship to box car. The copra or other bulk material is thus being delivered from the steamer's hold to the box car and properly trimmed in the car in one operation.

SHIP MOVED FROM ENGLAND TO LAKE IN THE ANDES

PORTABLE garages or houses are no novelty, especially in the United States where large mail-order houses are prepared to deliver all the necessary parts of such structures carefully marked to facilitate assembly. But who would think of purchasing in the same way a 950-ton steamer complete to the last detail? Just the same there is now being put together on the shores of Lake Titicaca, high up in the Bolivian Andes, a vessel that was built in England and then knocked down for convenient transportation first to Mollendo, Peru, via the Atlantic Ocean and the Panama Canal, and thence overland to Puno lying 300 miles in from the Pacific and more than 12,500 feet above sea level.

The vessel in question is the *Ollanta*, which is to take the place of two smaller and obsolete craft that have for years been carrying passengers and freight across Lake Titicaca, which is 60 miles wide and 140 miles long. Native-built *balsas* ply these expansive waters, but only the venturesome of the tourists will take a trip in these little rafts or floats. The *Ollanta* has a length of 265 feet and a beam of 35 feet, and is equipped with oil-burning engines. She was constructed at Hull, where she made her trial runs before she was knocked down, shipped to Mollendo, and hauled by rail up the steep Andean slopes to Puno, where the work of reassembling the steamer is now in progress.

Tests made by the Aluminum Company of America have revealed that, weight for weight, aluminum girders will carry 130 per cent more load than will steel.



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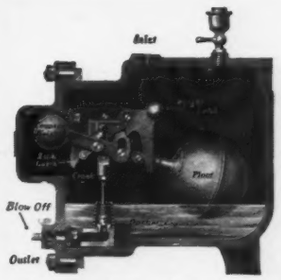

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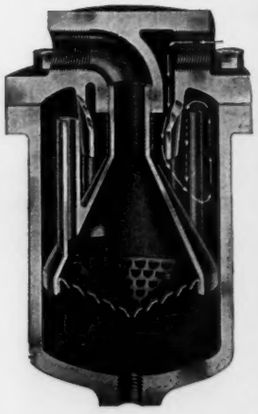

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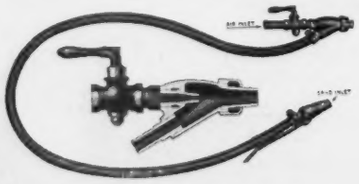

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